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FOR THE FEBRUARY ISSUE

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Railway Mechanical Engineer

Vol. 99 January, 1925 No. 1

More locomotive maintenance needed

Elsewhere in this issue will be found an abstract of the annual report of the chief inspector of the Bureau of Locomotive Inspection of the Interstate Commerce Commission which shows that during the fiscal year ending June 30, 1924, the commission's inspectors were compelled to order 5,764 locomotives out of service for the repair of defects which constituted violations of the law. In his report the chief inspector makes the following highly suggestive statement: "Conditions," he says, "are far from being satisfactory in so far as a proper compliance with the law is concerned. If due diligence is pursued by the carriers in seeing that locomotives are in proper condition and safe to operate before being offered for service, the commission's inspectors will not find it necessary to order any locomotives from service, which frequently causes serious inconvenience to the public as well as an added burden to the carriers."

It is evident, of course, that whether fully acceptable or not, neither the railroads nor the Bureau of Locomotive Inspection has any discretion as to observance of the rules and requirements of the Bureau, since they have the force of federal law. They are, however, generally conceded to be entirely sound and in fact represent nothing more than recognized good practice. Where conditions are permitted to develop which result in the necessity for removing locomotives from service to prevent violations of the law, it has been found that the railroads are not serving their own best interests. Entirely aside from the safety aspect of the case, with which the law is concerned, such conditions decrease the reliability of locomotives to such an extent that engine failures multiply and all of the attendant delays and expense are encountered in the conduct of transportation.

During the fiscal year ending June 30, 1924, there were considerably less locomotives out of service for repairs than during the preceding fiscal period. The number of accidents caused by failures coming within the scope of the law, however, is only about 10 per cent less than during the earlier period, and still much greater than during 1920, 1921 or 1922. This would indicate that although the number of locomotives actually reported unserviceable has been decreased, there was still much to be done in restoring a satisfactory amount of the mileage life to the locomotives in service, since many of the defects most commonly encountered are not likely to develop on power on which proper renewals and repairs have been made in the back shop. If conditions are to improve next year, then, the average number of months since shopping must be reduced. This will relieve the terminal organizations of excessive work on worn out power and make possible the current handling of such running repairs as are required.

One of the best indications available to the executive of the extent to which these ends have been accomplished will be found in the reports of its inspectors rendered periodically by the Bureau to each railroad. They should be followed closely and their indications used as a basis of action, not alone because this is required by law, but because in that way can the most economical and reliable locomotive service be obtained.

Mill room equipment and operation

One of the important factors in car shop operation is the mill room. Owing to the fact that this particular part of the car shop usually operates smoothly, providing lumber cut to size and machined as required, it frequently receives less attention than its importance warrants. The possibilities of material and labor saving or loss, dependent upon the way lumber is handled in mill rooms, are large. Some idea of the magnitude of railroad mill room operations in the aggregate may be gained when it is realized that the railroads purchase directly about 17.5 per cent of the annual timber cut of the country. Statistics of the Bureau of Railway Economics show that in 1923 the Class I railroads purchased approximately 2,388,800,000 board feet of lumber for which they paid nearly $100,000,000. The amount mentioned does not take into consideration lumber used for cross ties, poles, posts, etc.; therefore, a large proportion of the 2,388,800,000 board feet undoubtedly is handled in railroad mill rooms.

In mill room equipment one of the first essentials is an adequate supply of planers properly maintained so as to provide accurate, smooth and rapid work. The value of a four-side planer, particularly in shops which are pressed for output, can hardly be over-emphasized. This machine planes all four sides of a timber at the same time, eliminating three passes, and saving time and labor. It increases mill room and consequently car shop capacity. A full complement of saw equipment is required, including cut-off saws, self-feed rip saws, swing saws, band saws, etc. An adequate number of modern saw filing machines will assist materially in keeping these saws in the best condition for effective work. Other more or less standard tools which save labor and increase mill room efficiency and capacity are multiple spindle boring machines, jointers, mortisers, tenoners and gainers with boring attachments, multiple spindle shapers, dovetail machines, molding machines, automatic knife grinders, circular saw grinders, etc. One of the best labor saving tools in the pattern shop is the drum sander. This and other sanding machines greatly reduce the labor involved in finishing patterns and cabinet work to the required degree of smoothness.

Aside from machines of standard type many special machines have been developed by manufacturers and in some cases by railroad men which have proved effective

for such purposes as manufacturing wooden tie plugs and other similar items. When a mill room is properly equipped with modern machinery, the next essential is to arrange it so that the timber travels from one machine to the next through the shop, back travel being eliminated or reduced to a minimum. While many railroad mill rooms are now operating along the lines indicated with modern machinery and an up-to-date organization, the amount of money involved is such as to justify frequent checks to see if the most efficient operation is being secured, that needed machinery is available, that it is properly located, and that the mill room organization functions to the best advantage.

Why use inefficient boilers?

With the advent of extreme cold weather comes the realization on far too many northern railroads of the existence of a shortage of steam for heating and thawing purposes. This condition in itself is bad enough, but the remedy that is so often applied is worse. The installation of old locomotive boilers for stationary service is a practice that has very little to commend it. There is no condition, either from an operating or economical standpoint, that justifies a deliberate attempt to see how much coal can be burned in a given time and get so little from it. A locomotive boiler is an admirable steam generator when used on a locomotive with a strong induced draft, but when transferred to stationary service with natural stack draft or even mechanical forced draft, it leaves much to be desired as a means of efficient combustion. It will be argued that most installations of this kind are purely emergency ones and that the old locomotive boiler, even with its admitted inefficiency, satisfactorily meets the immediate demand because it can be quickly and cheaply put into service. The cost of operation, apparently, is not given very much consideration.

A suggestion in connection with this practice may not be entirely inappropriate at this time. A broad survey of the conditions surrounding the use of steam in yards and around engine terminals will very often disclose sources of enormous loss that are ordinarily overlooked. If proper attention is given to steam leaks at valves, hose connections, etc., as well as to the thorough lagging of all open steam lines, the present steam consumption may be materially reduced. A carefully prepared statement showing the distribution of steam uses, with particular attention to losses from leakage and radiation, will do more than any other one thing to emphasize the possibility of minimizing steam losses. If this subject is intelligently and thoroughly analyzed, the surprising discovery may be made that, by the expenditure of a comparatively small sum in proper maintenance and repairs, when the next season of cold weather approaches, the old locomotive boiler, instead of being drawn into a service where it can perform but poorly to say the least, may be consigned to the scrap pile where it belongs.

The machine tool outlook

Elsewhere in this issue appears an article on the machine tools purchased during 1924, which contains estimated expenditures on shop equipment for the coming year as well as a prediction that the budget figures given will be greatly exceeded at the end of the year. Predictions are easy to make but are far more effective if substantiated by facts. Let us see what facts there are to substantiate this forecast.

In order to purchase new equipment the railroads must first obtain the necessary capital. They have two means of doing this; first through net income and second, through the proceeds of the sale of an issue of bonds or stocks. Figures for the last four months of 1924 show that most of the railroads handled record breaking freight traffic which resulted in increased net operating income. This increase in net income was not due to a reduction in wages or taxation, or increase in freight rates, but largely through the increased efficiency of railroad operations. There is every reason to believe that this increase in traffic will continue in 1925. Since the presidential election, a steady increase of unfilled orders has been shown in the steel industry; there has been an increase of proposed construction work and a rise in the price of farm products which will increase the buying power of the farmer. These facts indicate that the railroads will be called upon to haul enormous freight tonnage during the coming year and this will ultimately result in increased net operating income.

The railroad officers have expressed optimistic views concerning freight traffic for the coming year. They are very cautious about making forecasts, but, in a series of articles by presidents of some of the leading railroads of the country published in the January 3 issue of the Railway Age they are unanimous in anticipating an increase in traffic for 1925.

It has always been much easier to raise capital with which to purchase railway equipment than for other purposes because equipment trust notes can be issued for the purchase of equipment, while practically all fixed improvements must be financed by the issuance of bonds or stocks or from net income. Therefore, the fact that the earning capacity of the railroads has been greatly improved due to increased traffic and to better operating efficiency will enable them more readily to finance permanent improvements in fixed property.

During the past year the railroads of North America have purchased 1,534 locomotives, 147,345 freight cars, 2,654 passenger cars and 130 rail motor cars according to compilations made by the Railway Age. For years the railroads have been making similar purchases of equipment and while a considerable portion of the new units is acquired to replace old units retired from service, there has been a steady increase in the number of locomotives and cars, and the replacements themselves have served to increase rapidly the average size of the units which must be maintained. This has not been accompanied by a proportionate increase in shop capacity or by the purchase of the modern machine tools required to meet the present demand for increased shop efficiency and, speaking generally, capacity to make needed repairs has long been taxed to the limit.

Railroad officers are rapidly coming to realize that much of the old machine tool equipment in the repair shops is obsolete and inefficient. An outstanding recognition of this fact is contained in the statement by L. F. Loree, president of the Delaware & Hudson, which appeared in the annual statistical number of the Railway Age, in which he said: "Perhaps the point in which railroad facilities are the weakest is in the machine tool equipment of the repair shops. The development of machine tools receives a great impetus from a war and from the growth of a new industry. During the past 15 years we have had the World War and the development of the automobile business. The effect has been to revolutionize machine tools and to render obsolete a large part of the machine tool industry."

The volume of machine tool purchases in 1924 indicates that the railroads have already taken a step forward in replacing their obsolete tools. In view of the promising business outlook for 1925 there is every reason to believe

that programs looking toward modernizing shop equipment will be developed on an even larger scale than during 1924.

Take up the lost motion

It is an established fact that one of the important factors in obtaining the maximum amount of output from a piece of machinery is to eliminate from it all lost motion. It is a common sight in the average busy locomotive repair shop to see workmen promenading up and down the aisles of the shops wasting valuable time that should be used for productive purposes. Upon investigation it will be discovered that these men are either going after tools or material, or are looking for the foreman to secure an order for material. Further investigation will reveal the fact that considerable time is lost in the morning and at lunch hour in starting promptly to work when the whistle blows. Some of the men will be found in groups engaged in a discussion of some sort; others may be reading, and still others taking a nap. These men will finish their discussion, complete the article they are reading, or slowly arouse from their sleep, gather their tools and amble back to their work. This is a daily occurrence and eats up valuable time.

Take, for an example, a locomotive repair shop employing 200 men. These men will average seven minutes a day getting started to work after the whistle blows (this is a very conservative figure). This will total up to approximately 47 man-hours a day, or 282 man-hours a week. Assuming an average of five minutes a day per man lost in securing tools, material or orders for material, which is a conservative average, in a week's time a total of 102 man-hours will be lost in this manner. These two items will amount to 384 man-hours a week, which, figured on a basis of 60 cents an hour, will amount to $230 a week, or $920 a month. If this is allowed to continue month in and month out, by the end of a year a little over $11,000 will be lost.

How can this situation be overcome? The time lost by the men in securing tools and material is a problem for the management to solve. The proper distribution of tools should be carefully studied and some means provided to reduce this source of lost motion to a minimum. One system of tool distribution which has been effectively used in various shops is to provide each machinist and his helper with a tool wagon in which to keep the tools he has occasion to use every day. Other tools, which are not so frequently used, are placed in the care of the foreman in charge who is held responsible for them. The specialization of mechanics on certain jobs keeps the number of tools required by each man within practicable limits for this scheme of distribution.

The distribution of material in railway shops has received considerable study in the past, but there is still room for improvement in many shops, especially in the convenient location of material stock bins in the shop for small parts. If the men are educated to the proper utilization of these bins, they will save themselves many unnecessary steps, and if they are working on a piecework basis, will increase their daily earnings. Another item which needs additional study is the method of giving out orders for material. In many shops the foreman in charge has to write out these orders. It is often the case that a workman seeking material, loses considerable time in locating the foreman before he can get an order for the material. A great deal of this lost motion could be overcome if the issuing of material orders were concentrated at one point in the shop where the men could get an order for what they want. This point should be situated on the way to the storehouse, or the point at which the material is kept; then no time would be lost.

After the management has, by the proper distribution of tools and materials, reduced to a minimum the non-productive hours lost through these sources, it is then in a position to solicit the co-operation of the men to do their part. When the men are convinced that the management is sincerely striving to eliminate wasteful methods and practices which, if accomplished, will benefit them as well as the company, then and only then will they co-operate in taking up the lost motion for which they are primarily responsible.

New Books

Eye Hazards in Industrial Occupations. *By Louis Resnick and Lewis H. Carris, 247 pages, 6 in. by 9 in. Price* $1.50 *with linen and* $2.50 *with fabrikoid binding. Published by the National Committee for the Prevention of Blindness, Inc., New York.*

The National Committee for the Prevention of Blindness has been doing much towards bringing to the attention of industry and the country at large, the means of eliminating the causes of eye injuries in industrial occupations. In publishing this volume, it has undertaken to serve as a clearing house for the great fund of information regarding this particular hazard which has been developed by the numerous industrial associations, governmental agencies and individual corporations interested in accident prevention and health promotion.

The volume has 10 chapters with 59 illustrations and three appendices. The various chapters include such subjects as the nature and cause of eye injuries, the elimination of eye hazards by engineering revision, first aid treatment for eye injuries, the correction of defective vision and diseases affecting the eyes. Railway officers and safety inspectors will be particularly interested in the chapters on industrial lighting and safety education. These chapters are well illustrated and the effects of poor lighting, the proper amount of illumination required in shop buildings, the education of officers and employees and the enforcement of safety rules and regulations, are discussed in an instructive and entertaining manner. Appendix I gives a list of industrial poisons that present hazards to the eyes. Appendix II consists of the goggle code of the American Steel and Wire Company. Appendix III is a supplementary reading list on the subject of eye hazards.

This handbook, which was written to replace publication 12, issued in 1917, furnishes a wealth of valuable information for safety engineers, inspectors, committeemen, physicians and nurses.

A Study of the Locomotive Boiler. *By Lawford H. Fry.* 157 *pages, illustrated. 6 in. by 9 in. Price* $4.00. *Published by the Simmons-Boardman Publishing Company,* 30 *Church street, New York.*

This volume is planned as a study of the operation of the locomotive boiler and to deal with tests and methods of testing. No particular attention is given to details of construction and familiarity with the general arrangement is assumed. Beginning with the experimental tests on locomotives of the Liverpool and Manchester Railway in 1834, the progress of testing methods is outlined down to the present time. The theory of combustion and the relation of various forms of fuel to the generation of steam in locomotive boilers are analyzed. In studying the operation of a locomotive boiler it is highly desirable to draw up a "heat balance"; that is to say, to ascertain how the heat available in the coal fired is distributed, to find what proportion is usefully employed in evaporation and how the remainder is divided among the various avenues of loss. Chapter III outlines the data necessary and the method developed for computing a heat balance. The chapter fol-

lowing offers for comparison a number of balances thus obtained. Chapter V deals with the detailed study of the processes by which the heat produced by combustion is taken up by the boiler heating surfaces. Two distinct and independent processes are involved; that of radiation from the fire to the firebox surface and that of transfer by contact of the heated gases with the cooler boiler heating surfaces. Equations are developed for carrying through the computations for both cases and typical examples given for applying these formulas. The following chapters deal with the transfer of heat from the gases to the flues with a consequent progressive fall of temperature of the gases as they pass through the flues and escape at the smokebox temperature. The general effect of the various conditions on the rate of heat transfer in flues is given with formulas from which the exact effect of these conditions can be computed. Tables to facilitate such computations are included.

A study of heat absorption as affected by the rate of operation and by the boiler dimensions and the methods of determining boiler efficiency constitute the final chapters in the book. Many useful tables, giving the results of tests, the proportions of boilers, combustion calculations, comparisons of calculated and test results and other data make up the final section in the book. For the designer, the railroad officer or student in locomotive design the information given in this book should prove of the utmost value as it is practically the only complete analysis of the physiology of the locomotive boiler; that is, the problems of the boiler that enter into the production of steam through the medium of proper combustion and the absorption of the developed heat by the boiler surfaces.

What Our Readers Think

Finding amount of wear in main rod brasses

LYNCHBURGH, Va.

TO THE EDITOR:

It is a regular occurrence for enginemen to report that both ends of the main rods are pounding badly. The usual manner in which the inspector determines the amount of wear in the brasses is to try them with a pin bar. This is a poor practice on account of the heavy weight of the modern main rod. Another way is to remove the brasses and caliper the pins and brasses. This method is positive but consumes a great deal of time.

I determine their wear by the tram method. I carry with me a small 5-in. by 2-in. tram. When the brasses of a locomotive are reported as having excessive wear, I have it spotted on the top quarter. I then put a center punch mark on the crosshead near the front end key and place one end of the tram in it. The hostler then applies the brakes, opens the throttle, and reverses the locomotive several times. In doing this a mark will be scribed on the main rod which, when measured, will show how much the brass will have to be closed.

The wear of the back end brasses may be determined in the same manner, except that the punch mark is put either on the eccentric crank arm or near the center of the main crank pin.

The amount that the driving box wedges are out of taper, can be determined in the same way. Place the locomotive over a pit and set the wedges up tight. Put a center punch mark near the top and bottom of the driving box. While the hostler is "pumping" the engine, scribe on the engine frame the amount the wedge is out of taper. This will give the amount to be planed off the wedge and also which end is to be planed. W. R. McIvor.

A word in favor of charcoal iron

PARKESBURG, Pa.

TO THE EDITOR:

In the September number of the *Railway Mechanical Engineer* there was published an abstract of a report of the committee on Pitting and Grooving in Boilers of the Master Boiler Makers' Association in which it was stated that: "It is generally believed that charcoal iron is more homogeneous than steel and that iron tubes are, therefore, more resistant to corrosion than are drawn steel tubes. Whether or not this is true, the writer is not prepared to say. It would seem as if steel could be made as homogeneous as iron and it is evident that if it were so made, it would be just as good."

There is another important reason for the superiority of charcoal iron boiler tubes, namely, the presence of slag, which is thoroughly distributed throughout the metal. The product of the charcoal knobbling fire is a sponge consisting of globules of practically pure iron, the pores of the sponge being filled with molten slag. The subsequent heating and mechanical operations necessary to convert the crude iron into a finished product, draw the slag out into filaments or thin strips which, while not continuous for the length of the tube, overlap to such an extent that every cross section of a charcoal iron boiler tube, will show a remarkably complete distribution of slag. An analysis of a finished tube or sheet of charcoal iron will reveal a surprising chemical uniformity.

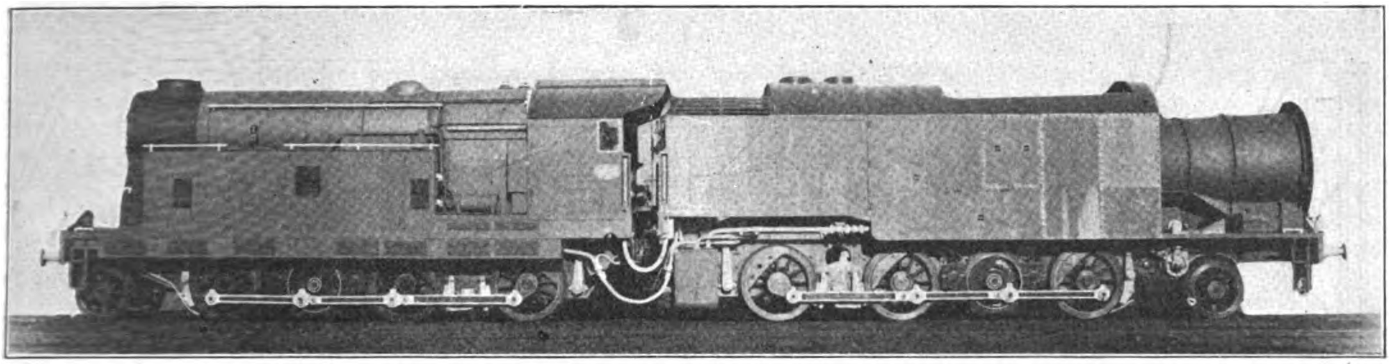
Steel on the contrary is purposely freed from slag before it is poured into the moulds where, on account of varying densities and gas pressure, the mass is in constant ebullution until it freezes. Due to this internal motion and the fact that the impurities are lighter than iron, they are found to be segregated, generally towards the top center, but also to a certain extent, throughout the entire ingot.

The presence of the slag or cinder filaments in wrought iron is responsible for the well known fibrous appearance of its fracture when nicked and broken. The resistance to fatigue shown by wrought iron, which is greater than that possessed by steel of an equal or even considerably higher tensile strength, is also very likely due to this subdivision of the cross section. In other words, the iron possesses to some degree, the greater resistance to repeated bending. This may be illustrated by a wire cable as compared with a solid bar of the same cross sectional area.

It is true that corrosion due to pitting is less likely to take place in a homogeneous metal than in one in which the impurities are segregated, by reason of the fact that chemical uniformity results in balanced electrical potentials. It is also recognized that no metal can be absolutely homogeneous and that under certain conditions pitting will occur. However, the point I wish to stress is that slag, being non-metallic, is definitely more resistant to the action of acids and to decomposition by electrolysis and consequently to corrosion in general, than pure iron. If corrosion does start, it is obviously of advantage to have within the metal barriers or obstacles of high resistance to corrosion to impede and check its progress so as to postpone failure or prevent it entirely.

This structural resistance to corrosion, possessed by charcoal iron, is of equal if not greater importance than the homogeneity of the metal in comparison with steel, in respect to the greater service that may reasonably be expected of charcoal iron. S. H. WOODROFFE.

Metallurgical engineer, Parkesburg Iron Co.



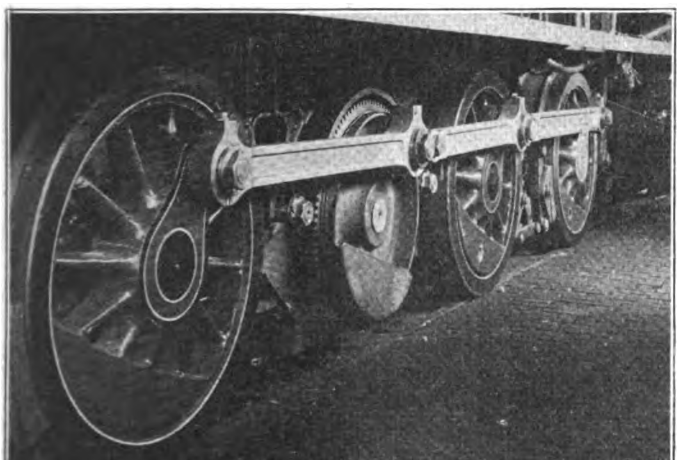
Side view of the Ramsay turbo-electric locomotive

Ramsay turbo-electric locomotive*

Practicable condenser of evaporative type developed—Speed of running controlled electrically

By George F. Jones and T. Laurence Hale

IT may be said that just as the cylinder, boiler and firebox have become fundamental parts of the ordinary locomotive, so do they determine the degree of its thermal performance and the limit of its possible power development. With the present-day demands for increased hauling capacity together with greater need for economy in fuel consumption, emphasizing, in these respects, the limitations of the orthodox designs of locomotives, it is not surprising to find engineers contemplating the attractive possibilities offered by locomotive development along lines other than the conventional.

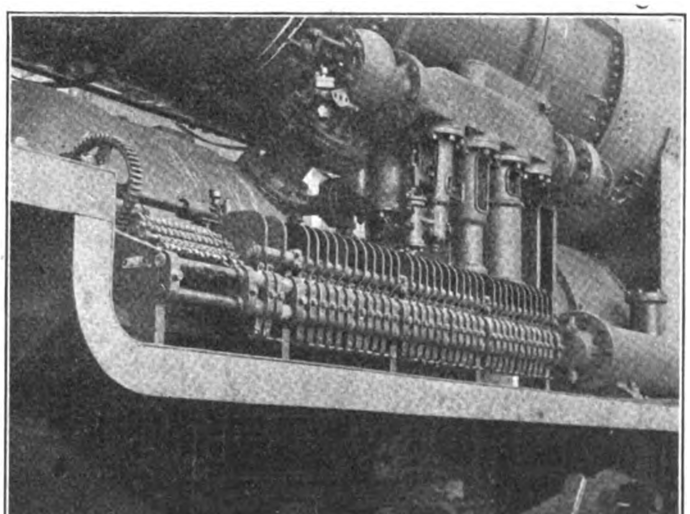


Power is transmitted to the driving wheels by a spur pinion and wheel which are enclosed, and run in an oil bath

It is apparent that there is great room for improvement when it is considered that a locomotive of the ordinary type has a thermal efficiency of only approximately six per cent and that doubling its thermal efficiency would reduce the fuel consumption by half or, alternatively, allow a much more powerful engine to be built with the present practical limits of firebox area.

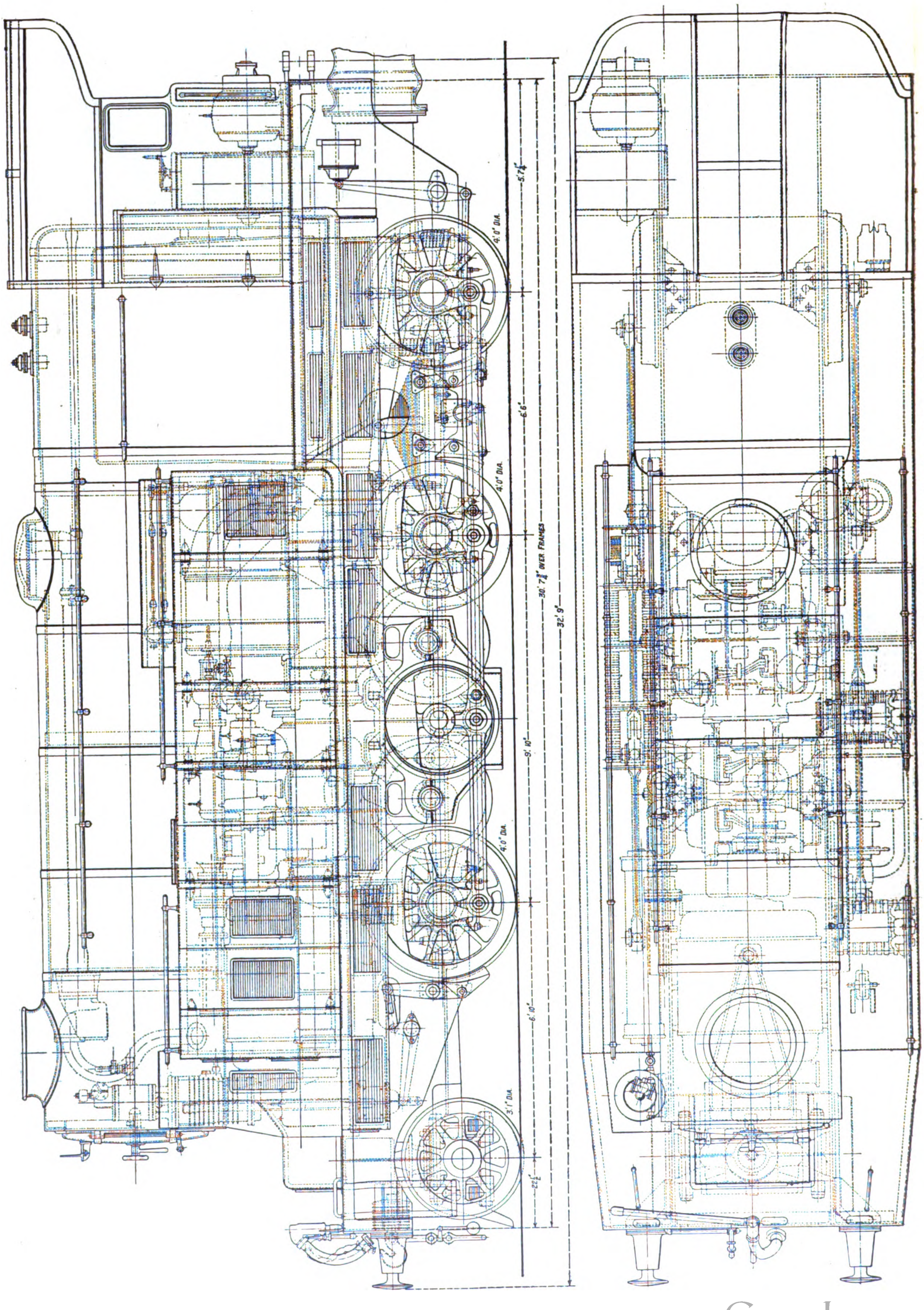
The replacing of cylinders by the steam turbine is an innovation in locomotive construction, but not more so than the application of condensation which is rendered possible by its introduction. From a thermodynamic point of view, it is evident that turbo locomotives, whatever their systems of power transmission, whether electrical or gear, largely depend for their economies in fuel consumption upon the efficiency and reliability of their condensing plant.

It is to be understood that the Ramsay locomotive is regarded as experimental, designed and constructed for the purpose of obtaining technical data and demonstrating the capabilities of the type. It conforms to British standard practice as regards the restrictions imposed by the load line gage, etc., although, naturally, in view of the radical departure in design, it has been confined mainly to test and demonstration running, rather than everyday service. It may be mentioned that compact and uniform designs were disregarded in the interests of experiment, the motor driven auxiliaries, in every case, having



Covers removed on right side to show the grid resistances and turbine governor

*Abstract of a paper presented before the annual meeting of the Railroad Division of the American Society of Mechanical Engineers.

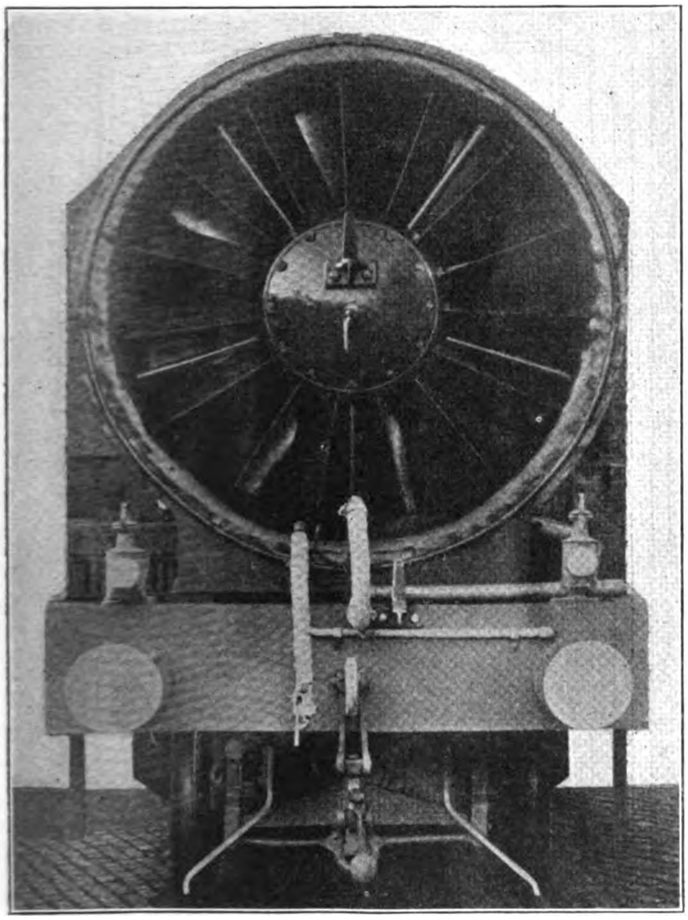


Elevation and plan of the forward section of the Ramsay turbo-electric locomotive

been purposely kept separate and ungrouped from the main power plant in order readily to obtain their particular power consumptions. In addition, many power registering devices, gages and instruments have been fitted, greatly in excess of those necessary to the ordinary equipment, all of which tend to give the locomotive, especially the cab, an intricate and complicated appearance.

General description

The locomotive consists of two portions, the front and rear, connected by a special form of universal joint. The front portion incorporates the boiler, forced draft set and driver's cab, the main turbo-alternator set and the auxiliary direct-current turbo generator being situated under the boiler. The rear portion of the locomotive is practically devoted to the condensing plant with axial fan, condensate extracting pump, etc. Room, however, has been found for the main water tank and coal bunker. Communication between the turbines and condenser is by way of the 24-in. diameter exhaust pipe which is provided with a flexible rubber connection reinforced by internal rings of aluminum.



Rear view of the locomotive showing the condenser fan

Each portion of the locomotive carries two driving motors, each pair of motors being bolted to a center cross-bearer which carries a transmitting shaft and spur wheels. Pinions are keyed to the motor shafts and these mesh with the spur wheels, the power being finally transmitted through coupling rods from the spur wheels to the driving wheels in the ordinary manner. One of the illustrations shows the spur wheel and pinion shafts, the pinions having been removed. Both are enclosed in a gear case and run in an oil bath. The gear ratio is 2.8 to 1.

The main turbine is of the impulse type and contains nine stages. The mean blade diameter is 36 in. It is designed for a steam pressure of 200 lb. per sq. in., and the steam is superheated to a total temperature of 685 deg. F., exhausting to a vacuum of 27 in. The turbine is flexibly coupled to a three-phase alternator and has a speed range of 1,800 r.p.m. at starting to 3,600 r.p.m. at 60 m.p.h. The three-phase alternator is designed to develop 890 kw. at a maximum pressure of 600 volts.

The auxiliary turbine is a single stage machine flexibly coupled to a direct-current generator, which provides the energy for the excitation of the main alternator poles as well as for the auxiliary direct current motors driving the condenser fan, condenser rotor, condenser extracting pump and the forced draft set for the boiler. It also supplies the necessary current for lighting the train. The auxiliary turbine operates under the same steam conditions as apply to the main turbo set.

The boiler is of the ordinary locomotive type and the combustion chamber is supplied with air by a high speed forced draft set situated on the locomotive cab. A simple locking device is provided on the furnace door to prevent a blow-back, the door being prevented from opening by a safety catch when the forced draft fan is in operation.

The transmission of power from the main turbine to the driving motors is three-phase, current being supplied from the alternator to the four alternating current slip ring motors, each motor having a continuous output capacity of 275 b.hp. and one hour's rating of 360 b.hp.

The following are the tractive forces at the rims of the driving wheels for the acceleration period from rest to 60 miles per hour:

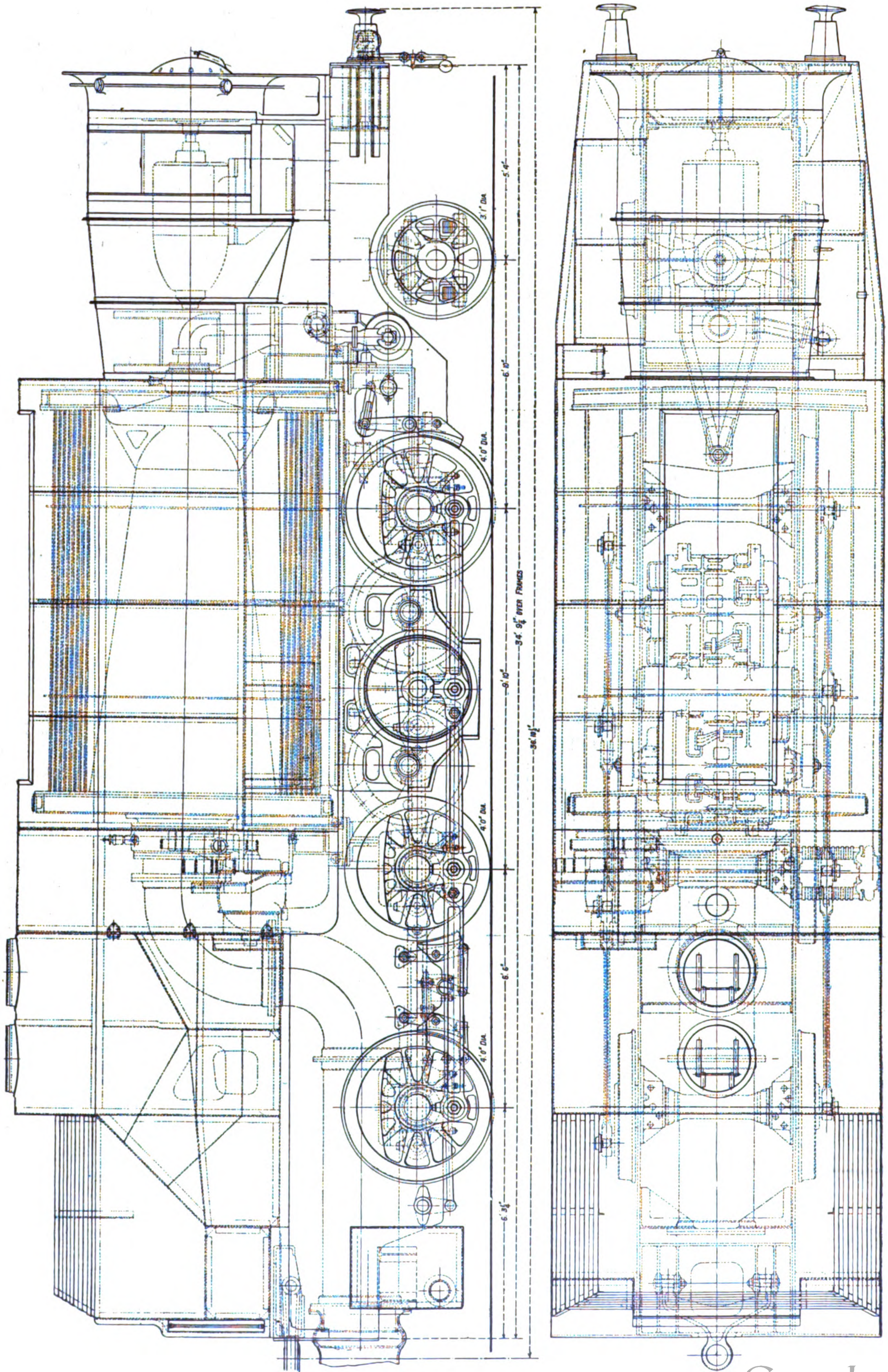
Miles per hour	Tractive force
Starting	22,000 lb.
15	22,000 lb.
30	11,050 lb.
60	8,600 lb.
Normal running, 60 miles per hour	6,000 lb.

Design and description of the condensing plant

As the success of a locomotive of this description depends in such a large measure upon the design and action of its condenser, it is perhaps not irrelevant to give a very brief review of the groundwork which influenced the adoption of the principle of evaporation as the basis of design for the present condenser.

In the light of previous experience of the difficulties of recooling condensing systems, it was decided to attack the exhaust steam by direct means. It was fully realized that the alternative method to evaporation, that of direct cooling by air alone, involved employment of large condensing surfaces and excessive fan power, and that such a type of condenser would depend for its success largely on atmospheric conditions, and, while probably producing a satisfactory vacuum in low temperature countries, the system would be at a great disadvantage and far from satisfactory in hotter climates. Attention was, therefore, turned towards evolving a suitable condenser on the direct cooling system based on the evaporative principle as being the system to successfully meet the atmospheric conditions of all countries.

In design, the ordinary evaporative condenser has progressed but little and still remains practically as originally conceived; such test results as existed were unreliable and it was, therefore, necessary to carry out a series of preliminary experiments on small scale condensing apparatus with fans to produce a current of air and so intensify the evaporative effect. The importance of maintaining a thin and unbroken water film upon the condensing surfaces was easily demonstrated and, of the numerous methods and contrivances tested with a view to producing satisfactory water filming of the surfaces under a blast of air,



Elevation and plan of the tender and condenser section

the simple method of completely immersing the surfaces in water before exposing them to the air current was found to give the most reliable and proper film effect. Repeated tests on a small condensing plant proved the type to be exceedingly economical in water consumption, in practice only approximately one pound of water being evaporated to condense one pound of steam. The fan power required was reasonably low while the rate of heat transmission was found to be moderately high and sufficient to bring the condensing surface well within the practical limits.

Further experiments were carried out on a plant containing some 400 sq. ft. of surface. For the sake of simplicity, the condensing surfaces were composed of ordinary brass condenser tubes and, as a natural development to facilitate the process of filming, they were arranged in the form of a circular cage, or hollow drum. The drum, supported between bearings, was rotated in a tank containing water, the tubes passing through the water as they rotated.

The condenser was supplied with air by an axial fan and was tested in conjunction with a steam regenerator and the necessary wet air pump, water filming of the surfaces and resultant evaporation taking place successfully. The promising results from this experimental work led to the design and construction of the present locomotive condenser.

Reference to the drawing shows the general arrangement of the rear portion of the locomotive. Ordinary condenser practice was observed in the construction of the drum, which consists of an annular nest of standard ¾-in. brass condenser tubes ferruled into two headers. The exhaust steam entering one header is condensed, and the resultant condensate is collected and drawn off from the other header and returned to the hot well by the rotary extraction pump as hot and clean feed for the boiler. The trunnions of the respective headers are fitted with air tight glands of the steam sealed self-adjusting type. This design of gland has given every satisfaction in resisting air leakage into the condenser.

As will be seen, a small motor, driving through a spur gear, turns the drum which is housed in a sheet metal casing, the bottom of which forms a tank containing the water for purposes of filming which is fed from the main tank. A pneumatic float maintains the water at a constant level.

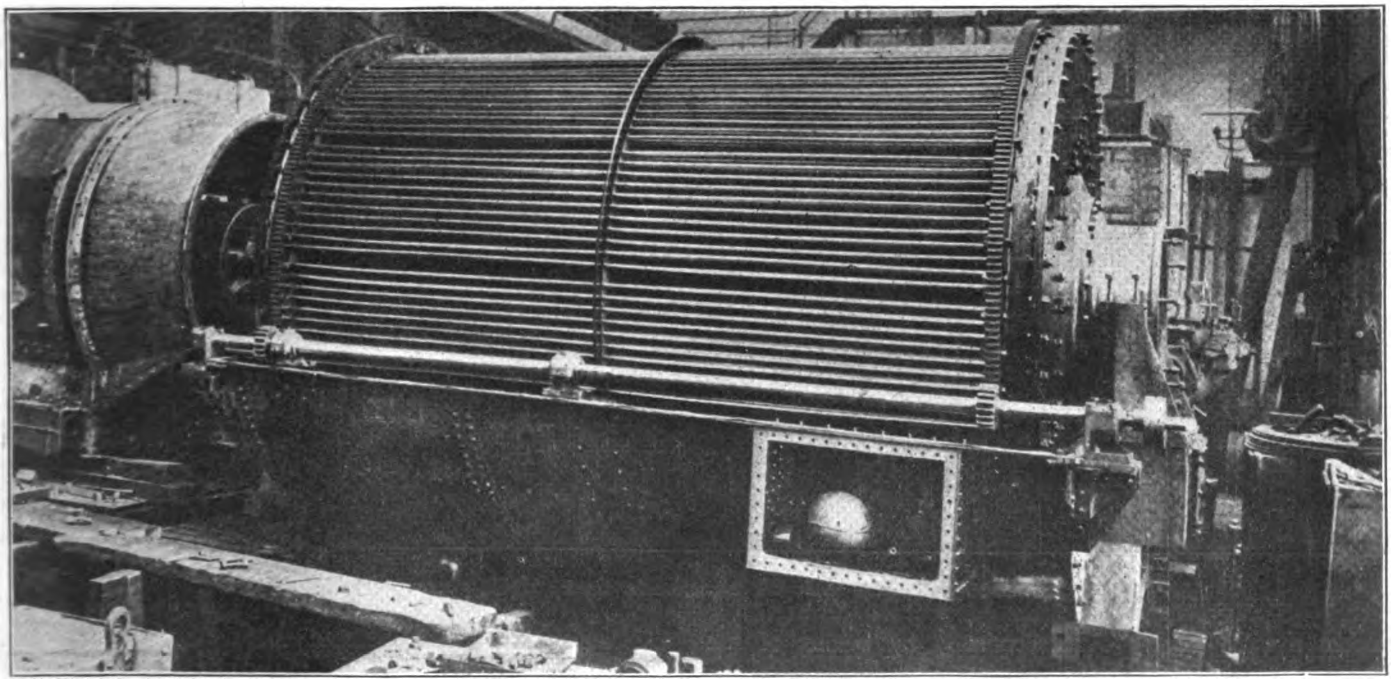
The condensate extracting pump is of the ordinary rotary condenser design, while the air pump is of the steam ejector type and has two stages; it is supplied with steam from the boiler through a reducing valve.

Before being erected on the locomotive, the complete condensing plant was fully tested in conjunction with a 1,500-hp. triple expansion engine and satisfactory results were obtained.

Control of power and speed regulation

As will be seen, the starting torque of the motors is about three times that of the normal and is obtained as follows: Before starting the locomotive, the auxiliary turbine is run up to speed, 3,000 r.p.m., thus providing excitation for the main alternator and energy for the motor-driven auxiliaries. The main turbine set is then run up to half speed; viz., 1,800 r.p.m. At this period the motors are connected in cascade by the master controller in the driver's cab. It is then that the locomotive may be started.

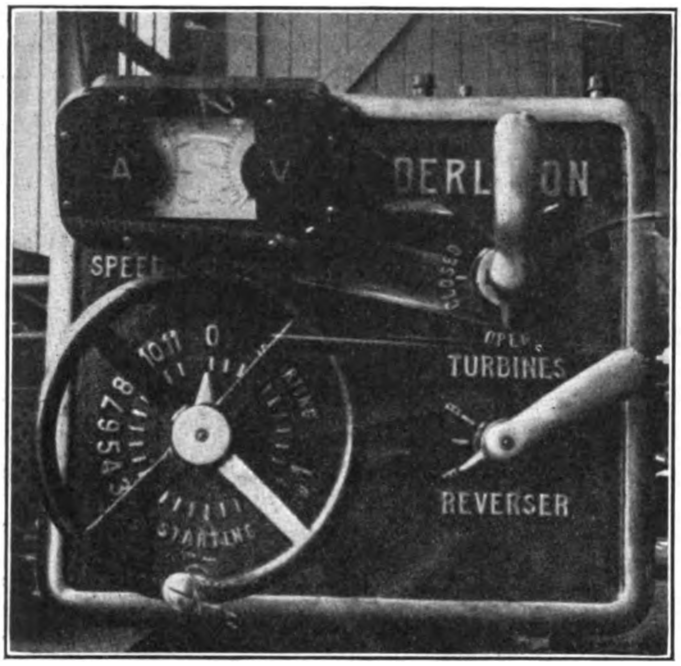
It is well known that when a turbine speeds up from rest to full speed, its torque decreases in the ratio of 2 to 1, and when passing through the period of half speed its torque is one and one-half times the normal. This is the torque of the main locomotive turbine when running at starting speed; namely, 1,800 r.p.m. Again, two alternating current motors when connected in cascade and running at half the alternator speed have twice the turning moment that they have when connected in parallel with the same power consumption. Therefore, with the driving motors in cascade and the main turbine running at half speed, the torque from rest to quarter speed will be two times 1.5, or three times the normal torque. The motors now being connected in parallel, the turbine still running at half speed, the speed of the locomotive increases from one quarter to one-half speed and the torque is then 1.5 times the normal. The turbine speed is then increased



General view of the condenser with its casing removed

to the maximum and the torque drops from 1.5 times the normal to normal.

In controlling the speed of the Ramsay locomotive from



The entire control of the locomotive is centered at this master controller

rest to 60 m.p.h., the following sequence of operations is observed: After the main and auxiliary turbines have been brought to speed by means of the hand wheels in the cab which control the steam inlets, all control of the locomotive is carried out electrically by means of the master controller in the cab. To start the locomotive, the controller wheel is moved to the first notch, thereby closing the excitation circuit of the alternator and connecting the driving motors in cascade with resistance wholly in circuit. Further movement of the control wheel cuts out resistance until a first running position of 15 m.p.h. is obtained. If a greater speed is desired, the controller wheel is moved further which changes the motor connections from cascade to parallel. The excitation circuit being again closed, the motors once more operate under current, resistance being cut out until a second free running speed of 30 m.p.h. is reached.

Further increases of speed are obtained by further moving the controller wheel around, step by step, whereby the setting of the main turbine governor is correspondingly altered, that is, the speed of the turbo-alternator is increased and thereby the periodicity. In this manner the speed of the locomotive can be increased from 30 to 60 m.p.h. A reduction in the speed of the locomotive is obtained by turning the controller wheel quickly back to the zero position, thus observing the reverse succession of operations to those of starting up to full speed. The excitation circuit being opened, the motors are without current and ready for starting up again in cascade.

Reversing the locomotive is, of course, effected by reversing the driving motors in the ordinary way. The general arrangement of the front portion of the locomotive is illustrated, showing the resistances, which are of the grid type, arranged under the running plates on either side. Both vacuum and Westinghouse brakes are fitted.

Principal dimensions and proportions

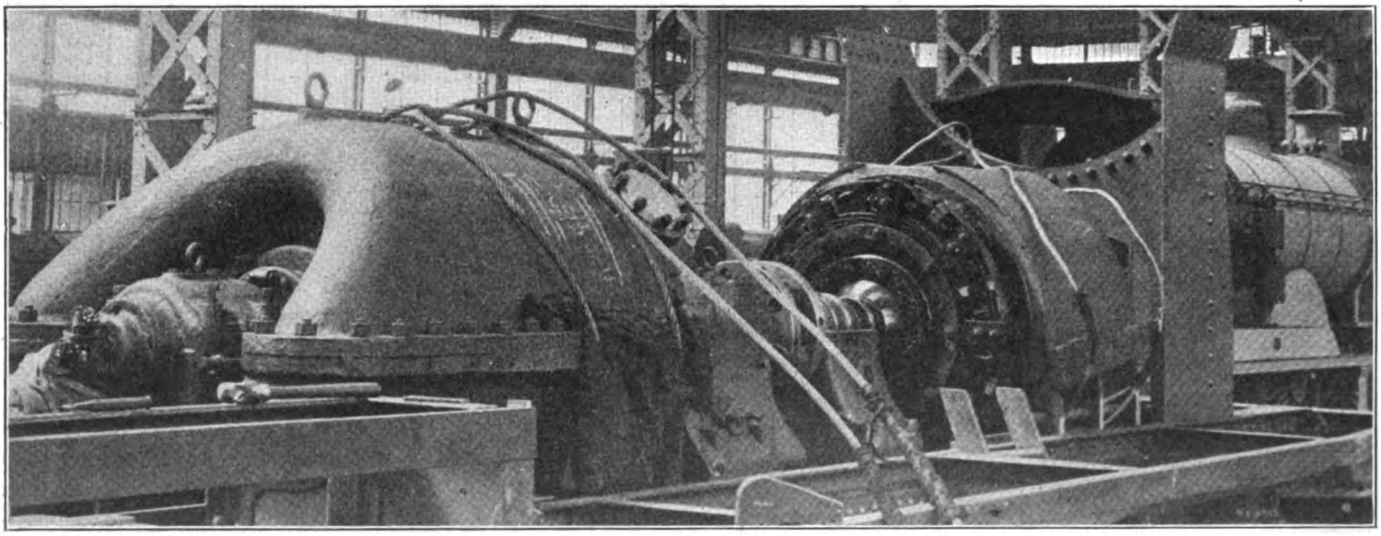
Length overall	69 ft. 7 in.
Length wheel base, total	59 ft. 4 in.
Length, rigid wheelbase	16 ft. 4 in.
Driving wheel diameter	4 ft. 0 in.
Height from rails to center line of boiler	10 ft. 3 in.
Maximum width	9 ft. 0 in.
Total heating surface of boiler	1,543 sq. ft.
Grate area	28 sq. ft.
Tractive force at starting	22,000 lb.

Shop and main line testing

The trials to which the Ramsay locomotive have been subjected have extended in one form or another over a prolonged period and often under adverse atmospheric conditions.

Shop tests, to ascertain the reliability of the special electrical control, were carried out before the locomotive proceeded to the Horwich works of the London, Midland & Scottish for actual running trials. By disconnecting the terminals of the alternator and connecting it to water resistance, it was possible to make many tests which did not justify a main line trail and afforded convenient means of obtaining readings on the condenser which would otherwise have been difficult to procure with the locomotive in motion. Numerous tests were made under these conditions and a large amount of technical data collected.

In addition, several main line trials have been accomplished and on these occasions the locomotive hauled heavy trains without difficulty, a vacuum ranging from



Turbo-generator unit on locomotive frame during assembly

80 to 95 per cent being regularly attained and held. Smoothness of running was pronounced, due to the constant and even turning moment exerted by the driving motors.

At no time during the run did the temperature of the condenser exceed 135 deg. F. which corresponds to a vacuum of 25 in. of mercury. The work of running and firing was carried out by ordinary railway employees and, as all the work in speeding up the locomotive is performed electrically, the duties of the engineman, so far as controlling the locomotive is concerned, are confined to the turning of the controller wheel, the operations of which have already been described, while the duties of the fireman are not as onerous as those connected with the ordinary locomotive.

In considering the efficiency of the condensing plant, some regard must be paid to the amount of power consumed in its operation, and, as in this case, the major portion of the cooling is due to evaporation, the power absorbed by the fan is proportionately low. The average power consumption for the three-condenser auxiliary motors ranges between 25 b.hp. at low loads to 40 b.hp. at high loads. The heat from the air ejector steam exhaust was recovered in the hot well.

No difficulties were experienced on account of deposits of scale and, although the filming water was far from pure, the slight scale which formed on the tubes assisted rather than impeded the water filming. Inspection of the inside of the tubes and headers showed them to be clean and free from deposit or corrosion after some months running.

The foregoing is but a brief description of a locomotive which has proved beyond doubt that the application of the turbine and condenser to locomotive use is rational and reliable. The transmission of energy from turbine to locomotive wheels may be either carried out by mechanical gears interposed between the turbine and wheels, or electrical means may be employed. For moderate powers, there is much to be said in favor of the former, but for large powers the balance of the advantages lies with the latter means.

The exhaustive tests taken over a long period have demonstrated conclusively that there is now little difficulty in providing condensing apparatus which will maintain the requisite economical vacuum when dealing with the heaviest traffic.

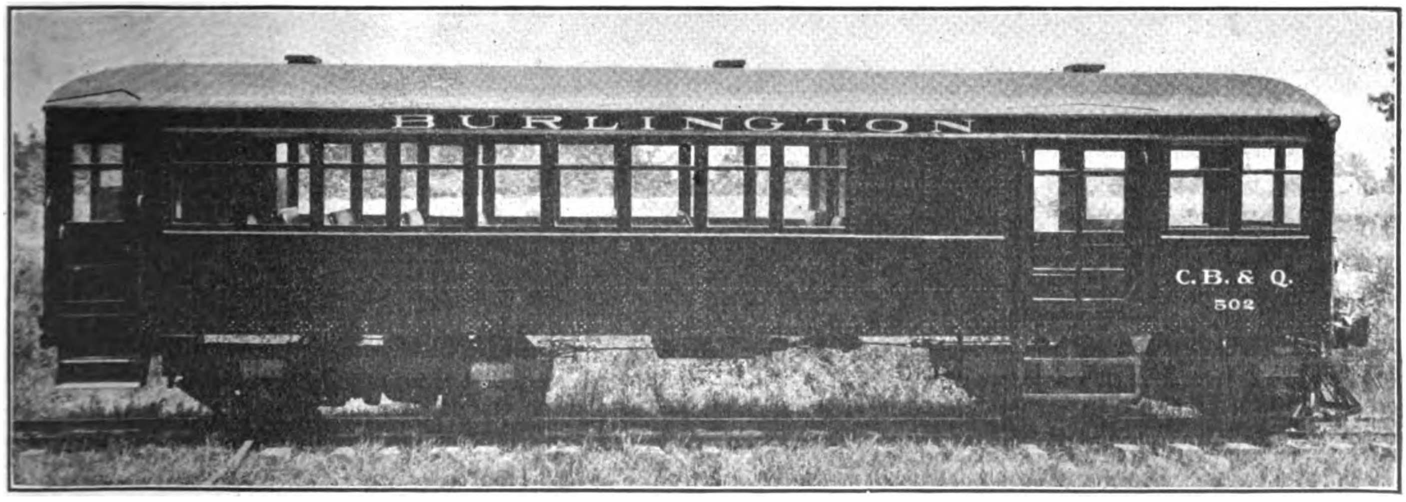
Gasoline car with independent power units

New self-propelled car for the Burlington embodies several unusual features of design

THE Edwards Railway Motor Car Company, Sanford, N. C., has recently completed a gasoline motor car for the Chicago, Burlington and Quincy which represents an interesting departure from the usual design of this class of equipment. The motors, one on each truck, are not only entirely removed from the car body with a consequent saving of space, but are arranged for independent operation, to permit handling the car under varying operating conditions with greater economy.

This car is equipped with two double trucks into each one of which has been built a complete power plant which can be operated independently or together as operating conditions may require. This construction serves to eliminate all direct motor vibration from the car body; eliminates universal joints, long drive shafts, angle drives and numerous gears. An additional advantage is the fact that no space is taken up in the car body for the motors. If one power plant should fail completely, the other unit remains to operate the car. This construction also has a maintenance advantage in that an extra or reserve power truck can be kept on hand and if a mechanical failure occurs, the trucks can be changed in about 45 minutes.

Both front and rear trucks follow closely the conventional four-wheel passenger coach type of construction, with such modifications as are necessary to install the power plant. Wheels are 30 inches in diameter, rolled



Edwards gasoline rail motor car with a motor on each truck

steel A. R. A. contour; outside journal boxes are used and are fitted with Hyatt roller bearings; the axles are four inches in diameter and are made of chrome nickel steel, heat treated. Coil springs are used over each journal box. One large transverse semi-elliptic spring is located under the bolster.

The power plant

Each power unit consists of one Buda four-cylinder motor, 5-in. bore by 6½-in. stroke, developing 60 hp. at 1,200 r.p.m. A heavy-duty multiple disc clutch transmits the power to a four-speed transmission of the constant mesh type which, together with a special final drive and reverse mechanism, provides the same number of speed changes in both forward and backward directions.

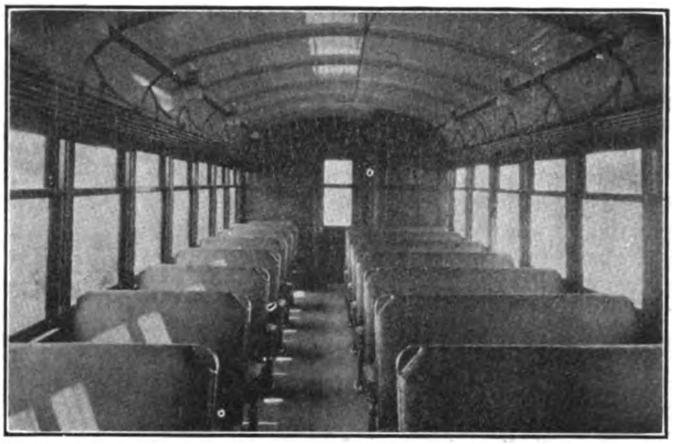
The complete power plant is mounted on a sub-frame which is suspended within the regular truck frame by four cantilever springs attached to swing motion hangers. The connection from the final drive to the axle is with two chains running in oil tight housings. This method of mounting, which is patented by the builder, permits the frame containing the power plant to move vertically or horizontally and as there is no rigid connection between the driven axle and the power plant frame, the driving machinery is protected from rail shocks and vibration, which is essential to the life of the machinery in a self propelled car, and especially so when the power plant is on the trucks.

One 65 gallon gasoline tank is located under the car body, arranged for convenient filling from the outside. This tank supplies fuel to both motors.

Over each motor there is placed a trap door in the floor which permits access to the motor for making all necessary adjustments, removal of cylinder heads, grinding valves, etc. The motors are also easily accessible from the outside of the car from each side. The truck can be removed from under the car in a very short space of time, and with the truck out the entire power plant is accessible for all kinds of repairs.

Each power plant has a separate set of controls so arranged that both motors can be operated separately or together as desired. A mechanical control, simple in construction is used because of the fact that in changing transmission gears, it is necessary for the operator to use the sense of touch and feel the gears in mesh, which can be done only with a mechanical control. For example, should the car be running with only one motor at a speed say of 25 or 30 m.p.h. and the driver sees the necessity of using the second motor to ascend a heavy grade, he can start up the second motor and put it directly in high gear without any clash of gears as he can easily bring the gears in mesh by the sense of touch.

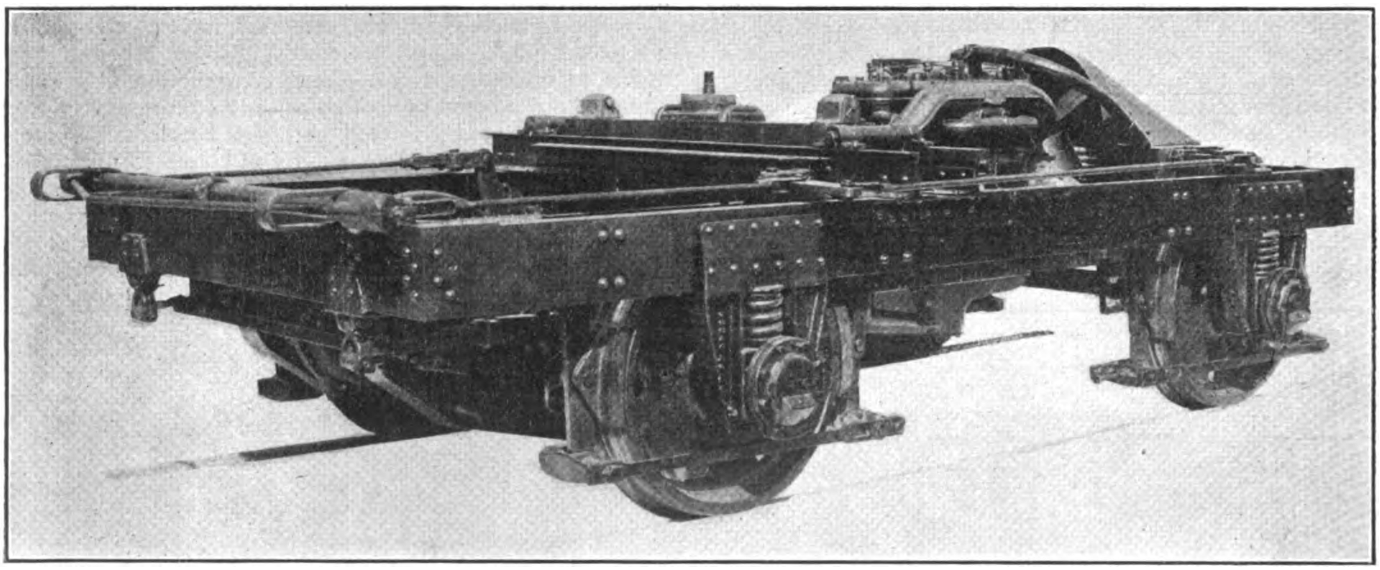
In some designs of self propelled railway cars, considerable power is taken from the motors operating the car for operating various accessories such as the air compressor, electric lights, radiator fan, etc. On this car, no power is taken from the driving motor for these purposes. The total horsepower output of the motors is used to propel the car.



Interior view of the passenger compartment

The two engine principle offers possibilities for economy in that it permits the use of one engine on level track and with light loads, and both engines on grades and for heavy loads. The power and fuel consumption thus keeps pace with actual needs. In handling heavy loads this method reduces to one half the amount of load and strain on the clutch and transmission gears as compared to cars with only one power plant, thus reducing the wear and maintenance of these parts. The car is so designed that when only one power plant is used, none of the parts or machinery of the second power plant are in motion (except the drive sprockets and chains). Therefore, there is no wear on the power plant that is not in use.

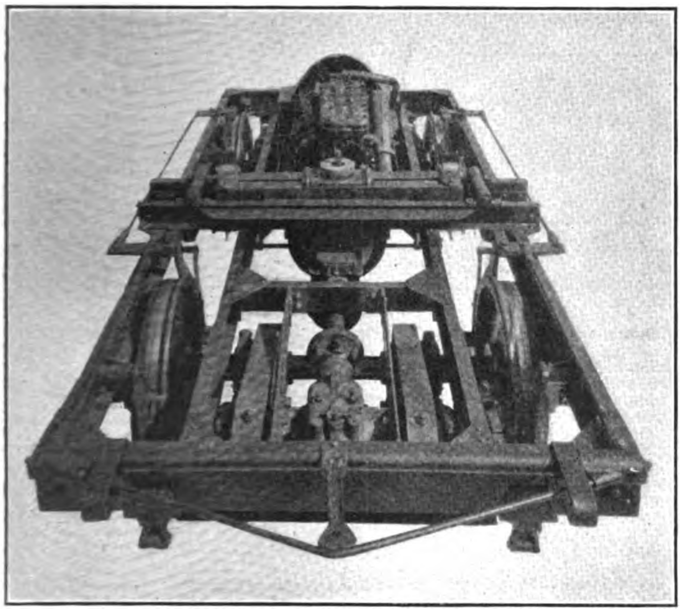
A Kohler automatic light and power plant is installed



Rear and side view of the truck, showing the brake arrangement and journal boxes

in the driver's cab. This plant furnishes 110-volt direct current for operating the lights of the car, driving the air compressor and operating the motors of the heating system. The lighting plant has 2,000 watts capacity and is driven by a small 3-hp. 4-cylinder motor, the complete unit occupying a floor space of only 15 in. by 33 in. In addition to the above electric plant, each driving motor is equipped with a generator, self-starter and a storage battery. This system will also supply current to several auxiliary lamps located in the car for emergency use. The electrical equipment includes a powerful 240-watt headlight.

A complete standard Westinghouse air brake system of the straight air type with emergency feature is installed on the car. The air compressor is of the regular street car type, operated by the auxiliary power plant. In addition to this air brake system, there is an efficient hand brake system operated by a ratchet located conveniently for the driver.



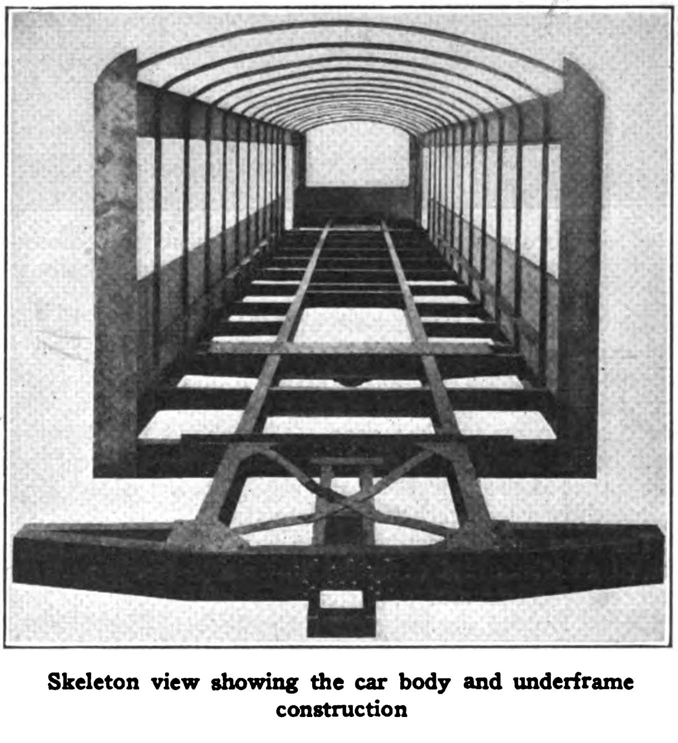
Top view of the truck, showing the motor suspension and driving arrangement

In view of the fact that the motors drive separate axles and are in no way connected except through the rails, it is not necessary that they be perfectly synchronized. Through the control system, the motors are synchronized near enough for all practical purposes. In operation no loss of power can be detected due to any failure of perfect motor synchronization. It is possible to cut either motor in or out while the car is in motion. When 75-hp. motors are used, a maximum speed of 45 m.p.h. can be obtained on level track and with 100-hp. motors 55 to 60 m.p.h. The car will operate at the same speed in both forward or backward directions.

The car body is constructed of steel with wood interior finish. The center sills are 8-in. 20.5-lb. I-beams. The side sills are ⅜-in. by 3½-in. by 6-in. steel angles; the cross members are pressed steel shapes. The side posts are steel tees ¼ in. by 1¾ in. by 1¾ in. These tees also form the car-lines and are in one continuous piece, running from side sill to side sill. The corner posts are formed from 12-gage steel and run from side sill to letter panel. The side sheeting and letter panel is 16-gage patent leveled copper bearing steel. The letter panel extends about six inches back on top of the roof and is flanged down to form a stiffener for the roof. The roof is of the turtle back type, extending the full length of the car. Roof boards are ⅜-in. by 2½-in. tongue and grooved poplar, dressed to a smooth surface, painted and covered with canvas bedded in white lead. The rear platform is of the enclosed vestibule type with trap doors over the steps. The floor inside is laid with yellow pine of double thickness with a deadening felt between the layers. The inside finish, consisting of doors, sash, partitions and panels below the rail, is birch, stained natural mahogany. The car has one toilet with dry hopper and a Dayton sanitary water cooler. Parcel racks are provided in the passenger compartment which run the full length on both sides over the seats. The seats are of the non-reversible type with pressed steel pedestals, wall and aisle plates, upholstered in leather. The seats on one side of the aisle are 52 in. wide for three passengers and 34 in. wide on the other side for two passengers. This leaves a 23-in. aisle through the car. The total seating capacity is 41 passengers. The principle dimensions of the car are as follows:

Total length of car	43 ft. 0 in.
Length over car body	42 ft. 11¼ in.
Length of baggage compartment	17 ft. 0 in.
Width of baggage compartment	9 ft. 1 in.
Length of passenger compartment	22 ft. 7 in.
Width of passenger compartment	9 ft. 1 in.
Width over sheathing	9 ft. 6 in.
Height from floor to ceiling	8 ft. 0 in.
Height from rail to top of car	12 ft. 4 in.
Height from rail to floor	4 ft. 3 in.
Bolster centers	25 ft. 6 in.
Total weight	39,000 lb.

Attractive electric light fixtures are provided throughout the car. Other equipment consists of signal bell, air sanders, alarm bell operated by air, electric classification lamps, fire extinguishers and hot air heating system. Special light weight standard M.C.B. couplers are provided at both ends of the car, fixed at the standard draw bar height.



Skeleton view showing the car body and underframe construction

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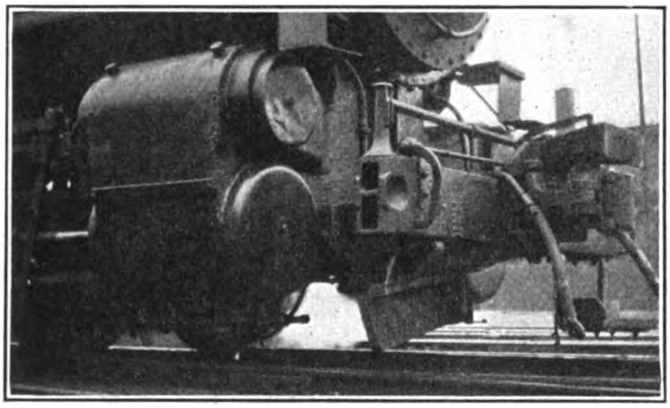
THE DETROIT, TOLEDO & IRONTON, aiming to provide safety in the greatest possible degree, has established a rule requiring that when cars are being pushed, particularly in yards and on industrial tracks, a brakeman must be stationed on the leading car, and he must have a mouth whistle. The same rule applies when yard engine, either pulling cars, or without cars, is moving backward; the brakeman must be on the footboard of the tender.

Bureau of Locomotive Inspection report

Conditions show the need for more careful inspection and thorough repair

THE thirteenth annual report of the chief inspector of the Bureau of Locomotive Inspection to the Interstate Commerce Commission for the fiscal year ending June 30, 1924, shows a reduction in the number of accidents and also in the number of persons killed and injured. A total of 1,005 accidents occurred in 1924 which were due to defective, inoperative or missing parts. The greatest number of accidents was due to defective grate shakers of which there were 96, 83 accidents were due to defective reversing gears, 66 to defective squirt hoses, 51 to injector steam pipes, 43 to boiler explosions, 41 to defective flues and 38 to defective brakes and brake rigging. An abstract of the report follows:



This footboard was caught on a frog and bent back, causing the trainman to be thrown to the track and seriously injured

The percentage of locomotives found defective decreased from 65 per cent during the year 1923 to 53.4 per cent during the last year. This shows an improvement in the condition of motive power during the year, yet below that of the year 1922, when 48 per cent of the locomotives inspected were found defective.

The condition of motive power is reflected in the number of accidents and casualties to persons resulting from failures of parts and appurtenances of locomotives and tenders. During the last year there were 1,005 accidents, resulting in the death of 66 persons and serious injury to 1,157 others. While this is a reduction as compared with the previous year, it is a material increase over the year 1922, when there occurred 622 accidents resulting in the death of 33 persons and the serious injury of 709 others.

During the year there were 43 boiler explosions, which resulted in the death of 45 persons and the serious injury of 59 others. The statement made above with respect to the total number of accidents during the year also applies to accidents due to explosions. The total explosions during the year decreased 24.6 per cent as compared with that of the preceding year, but an increase of 30 per cent over the year 1922.

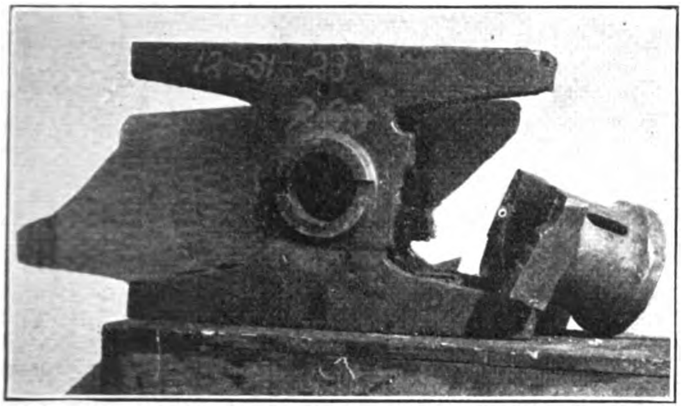
Attention is called to the increased seriousness of explosions as reflected by the loss of life. The effect of a boiler explosion is in direct proportion to the size and suddenness of the initial rupture which causes the explosion and the temperature and volume of the water in the boiler at the time of the accident. The volume of water increases with the size of the boiler and the temperature of the water increases as the steam pressure increases, consequently the failure of a large boiler carrying high pressure is much more serious in effect. This is illustrated by the fact that 57 explosions during the year 1923 caused the death of 41 persons, while 43 explosions during the last year caused the death of 45 persons. The

NUMBER OF LOCOMOTIVES REPORTED, INSPECTED, FOUND DEFECTIVE, AND ORDERED FROM SERVICE

Parts defective, inoperative or missing, or in violation of rules	1924	1923	1922	1921
Air compressors	1,221	1,390	971	692
Arch tubes	272	468	151	160
Ash pans or mechanism	257	306	161	147
Axles	19	21	15	12
Blow-off cocks	965	1,578	975	969
Boiler checks	1,329	1,913	949	1,006
Boiler shell	2,103	2,370	1,598	1,550
Brake equipment	6,920	8,213	4,577	4,836
Cabs or cab windows	1,627	1,423	1,276	1,171
Cab aprons or decks	1,293	1,476	1,098	893
Cab cards	758	1,449	567	671
Coupling or uncoupling devices	398	634	423	547
Cross heads, guides, pistons, or piston rods	3,577	5,527	1,920	2,116
Crown bolts	418	630	331	392
Cylinders, saddles, or steam chests	5,712	4,875	3,234	3,304
Cylinder cocks or rigging	2,376	1,745	1,201	1,197
Dome or dome caps	494	626	331	396
Draft gear	1,981	2,613	1,526	1,418
Draw gear	4,160	4,513	3,042	3,134
Driving boxes, shoes, wedges, pedestals, or braces	3,722	4,269	2,776	3,361
Fire-box sheets	1,471	2,327	1,191	1,185
Flues	698	1,268	521	552
Frames, tail pieces, or braces, locomotive	2,580	2,683	2,078	1,998
Frames, tender	414	540	352	232
Gage or gage fittings, air	626	1,062	399	537
Gage or gage fittings, steam	2,026	3,075	1,595	1,769
Gage cocks	3,835	5,895	3,275	3,657
Grate shakers	1,006	569	425	565
Handholds	2,241	1,990	1,533	894
Injectors, inoperative	94	251	94	179
Injectors and connections	9,985	12,406	7,741	7,606
Inspections or tests not made as required	9,740	7,419	4,114	4,865
Lateral motion	939	1,625	976	1,065
Lights, cab or classification	72	90	80	86
Lights, headlight	904	1,164	705	539
Lubricator or shields	565	566	456	427
Mud rings	1,901	2,711	1,598	1,441
Packing nuts	3,304	4,755	3,151	3,294
Packing, piston rod and valve stem	3,187	3,359	1,756	2,176
Pilot or pilot beams	967	1,294	679	588
Plugs or studs	1,026	857	443	457
Reversing gear	1,217	1,272	789	745
Rods, main or side, crank pins or collars	6,507	10,080	3,915	4,464
Safety valves	188	192	162	144
Sanders	1,806	1,857	1,165	1,071
Springs or spring rigging	6,335	7,911	5,497	5,494
Squirt hose	1,221	1,098	935	916
Staybolts	916	1,313	722	716
Staybolts, broken	5,320	10,089	4,261	4,871
Steam pipes	2,305	2,467	1,461	1,678
Steam valves	981	1,168	791	792
Steps	2,829	3,289	2,038	1,917
Tanks or tank valves	3,393	3,788	2,817	2,385
Telltale holes	620	715	630	567
Throttle or throttle rigging	2,868	2,633	1,880	1,730
Trucks, engine or trailing	3,425	3,899	2,467	2,493
Trucks, tender	5,977	3,714	2,551	2,408
Valve motion	1,269	1,761	710	691
Washout plugs	3,204	3,641	2,449	2,306
Water-bars or combustion flues	18	24	57	24
Water glass, fittings, or shields	4,201	5,641	3,640	4,045
Wheels	2,996	4,371	2,410	2,802
Miscellaneous—Signal appliances, badge plates, brakes (hand)	1,342	972	403	504
Total number of defects	146,121	173,840	101,734	104,848
Locomotives reported	70,683	70,242	70,070	70,475
Locomotives inspected	67,507	63,657	64,354	60,812
Locomotives defective	36,098	41,150	30,978	30,207
Percentage inspected found defective	53	65	48	50
Locomotives ordered out of service	5,764	7,075	3,089	3,914

reason that more people are not killed and injured by locomotive boiler failures is due to the fact that there are usually only two persons on the locomotive at the time of the accident. If such explosions were to occur at stations or other congested places, the results could not be estimated. These facts forcibly demonstrate the necessity for a high standard of construction, maintenance, and operation of locomotives. Because of defects developing from day to day and trip to trip, the utmost diligence must be pursued if serious accidents are to be avoided.

While most of these explosions were caused by the



Both webs of this crosshead contained old fractures extending over 75 per cent of the cross-sectional area

crown sheet having been overheated due to low water in the boiler, contributory defects or causes were found in 52.4 per cent of the cases, which again illustrates the necessity for better construction, inspection, and repair of all parts and appurtenances.

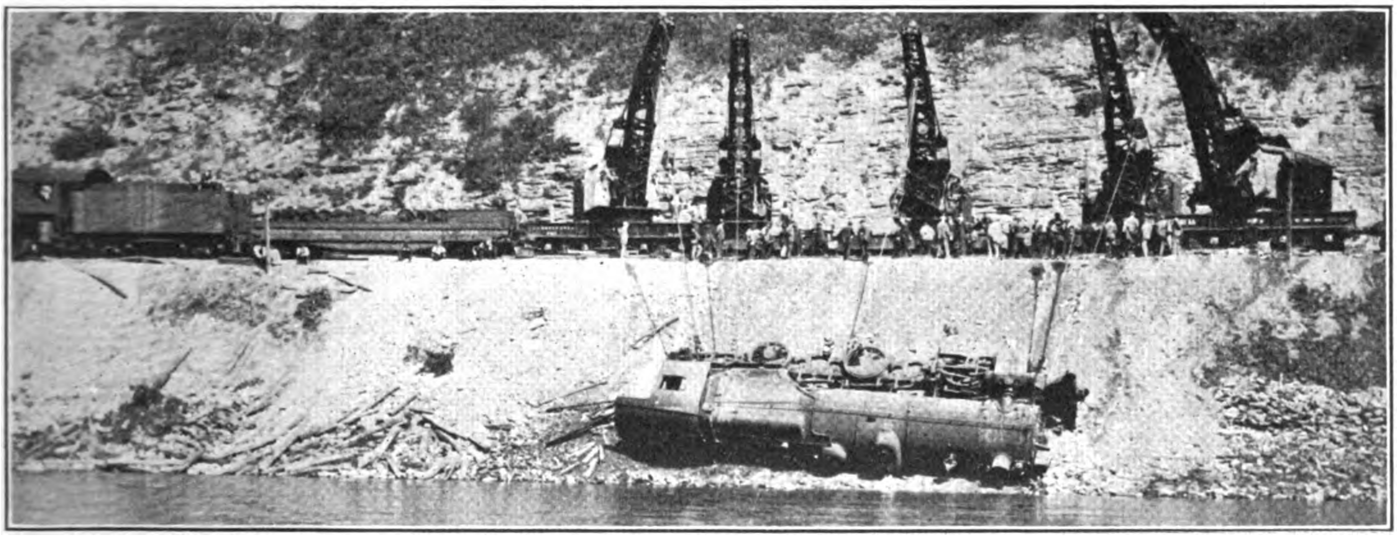
In the ninth, tenth, eleventh, and twelfth annual reports reference is made to investigations and tests made by this bureau on a number of railroads to determine the action of water in the boiler and its effect upon the water-indicating appliances. These investigations established without question that gage cocks when screwed directly into the boiler do not correctly indicate the general water level while steam is being rapidly generated and simultaneously escaping from the boiler. It is recommended that a suitable water column be applied to the boiler with three gage cocks and one water glass attached, with an additional water glass applied on the left side or boiler back head so that those operating the locomotive may have accurate knowledge of the general water level in the boiler under all conditions of service.

The water column as recommended is the most accurate device yet invented for this purpose. Accurate knowledge of the height of the water in the boiler is most essential to safe and economical locomotive operation. Water columns, as recommended, have been applied to practically all new locomotives constructed since the publication of our report and to a large number of locomotives previously in service. It is essential to safe and economical locomotive operation that water glasses and gage cocks be so constructed, located, and maintained that they not not only register the correct height of the water in the boiler, but that they be conveniently located and easily seen and read by the engineman and fireman from their usual and proper places in the cab. The duties of locomotive enginemen are among the most hazardous and exacting. Anything that detracts their attention for any length of time from the track and signals ahead creates peril to locomotive and train operation.

Autogenous welding has not yet reached a stage of development where it can be safely used on any part of the boiler where the strain to which the structure is subjected is not carried by some other construction which conforms to the requirements of the law and rules. This is also true in the case of fire-box crown-sheet seams where overheating and failure are liable to occur, on sheets which have been weakened from any cause to the extent of becoming unsafe and on seams on the boiler back head, except where the welded seams are covered with a patch applied with patch bolts, studs, or rivets which will prevent the escape of scalding water and steam into the cab, should the welding fail.

The most prolific source of casualties due to failure of autogenously welded seams has been in fire-box crown sheets and it has been conclusively demonstrated that the loss of life and limb due to fire-box failures depends very largely upon whether or not the sheets or seams tear.

Approximately 78 per cent of autogenously welded seams involved in fire-box failures have torn, while 15.4 per cent of riveted seams involved have failed. The fatalities where sheets tore have been about eight times as great as where they did not tear. From July 1, 1915, to June 30, 1924, autogenously welded seams were involved in 26.9 per cent of the crown-sheet failures, while 50.7 per cent of the total persons killed in such accidents was where the autogenously welded seams were involved. From the standpoint of safety, this clearly shows the



Locomotive derailed by the failure of a lug on a driving spring hanger gib, which allowed the hanger to work off the gib

necessity for construction of fire-box sheet seams in the strongest practical manner, especially in the so-called "low water zone", or on such seams as may be within 15 in. of the highest part of the crown sheet measured vertically.

The autogenous welding process is in a state of development and in order to avoid hindering the progress or development of any process of such great value when properly and discreetly used, the Bureau of Locomotive Inspection has hesitated to ask the commission to establish or approve rules or regulations restricting its use which might retard its development. However, unless the carriers confine its use to parts and appliances where there is less possibility of failure, accidents and injuries recommendations for more restrictive measures will have to be made in the near future.

Soon after July 1, 1922, it was brought to the attention of the commission that inspections, tests, and repairs were not being made by many of the carriers as required. It therefore became necessary for our inspectors to obtain information to show that locomotives were being used while in violation of the law so that court proceedings could be instituted. It was also necessary that our inspectors issue special notices for repairs in accordance with sections six and nine of the law, witholding 7,075 locomotives from service during that year until proper inspections and repairs were made. During the last year our inspectors were compelled to issue special notices for repairs which ordered 5,764 locomotives out of service.

Considerable improvement has been made by a large number of carriers, yet conditions are far from being satisfactory in so far as a proper compliance with the law is concerned. If due diligence is pursued by the carriers in seeing that locomotives are in proper condition and safe to operate before being offered for service, the commission's inspectors would not find it necessary to order any locomotive from service, which frequently causes serious inconvenience to the public as well as the imposition of an additional burden upon the carriers affected.

Result of a boiler explosion due to low water

Derailments of locomotives on curves

A practical application—The factor of wheel bearing is worked out for a 2-10-2 type

By Roy C. Beaver and Marion B. Richardson†*

Part II

IN order to illustrate the practical application of the analysis given last month, let us consider the case of a Santa Fe type locomotive having the weights and dimensions given in Fig. 9. First find the actual weights on the rails under each wheel. Referring to Fig. 6 let $d = 60$ in., which is the gage of the track plus the width of one rail head plus the widening of the gage on the curve. Also let the height of the center of gravity of the locomotive be $h = 96$ in. and the elevation of the outer rail be $e = 4$ in. Then, from the formula $e^1 = \frac{eh}{d}$ we find the value of e^1 to be 6.4 in. Then we may reduce the formulas $R = \frac{W\left(\frac{d}{2} - e^1\right)}{d}$ and $R^1 = \frac{W\left(\frac{d}{2} + e^1\right)}{d}$ to $R = .393W$ and $R^1 = .607\ W$ for the outside and inside wheels respectively. Using these formulas and the weights given in Fig. 9, we obtain the following results:

Location	Wheel	Lb.
Leading truck	Outer	11,200
	Inner	17,300
First driver	Outer	22,165
	Inner	34,235
Second driver	Outer	21,969
	Inner	33,931
Third driver	Outer	23,816
	Inner	36,784
Fourth driver	Outer	23,501
	Inner	36,299
Fifth driver	Outer	23,698
	Inner	36,602
Trailing truck	Outer	22,990
	Inner	35,510

Considering the coefficient of friction between the wheel and the rail to be .20, and multiplying the above weights on the drivers by this factor, we obtain for the forces necessary to slide the wheels the following amounts:

Driver	Outer wheel, lb.	Inner wheel, lb.
Front	4,433	6,847
Second	4,394	6,786
Third	4,763	....
Fourth	4,700	7,260
Fifth	4,740	7,320

Now suppose we have two trailing truck centering springs in tandem, each spring having an outer coil 8 in. in diameter of 1-in. round steel and nine coils and an inner coil 5½ in. in diameter of ⅝-in. round steel and 15 coils. Also, let each spring have an initial compression of four in. and a further compression, due to curvature.

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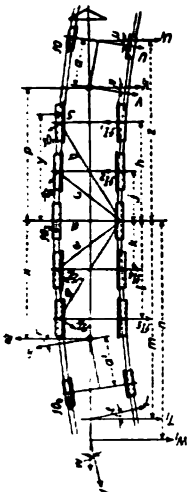


Fig. 5—The forces and reactions of a locomotive when curving

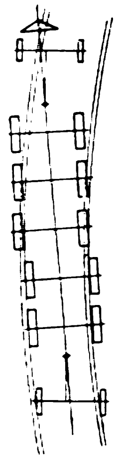


Fig. 3—Position a locomotive tends to assume when the guiding forces are removed

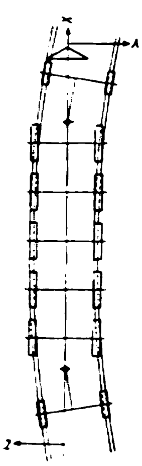


Fig. 2—A locomotive without flanges on a track

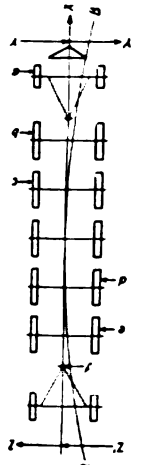


Fig. 1—A locomotive without flanges on a plane surface without rails

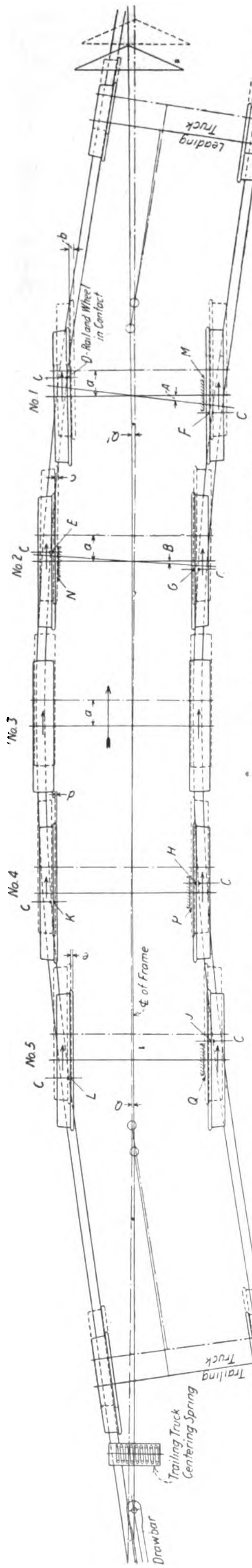


Fig. 4—A locomotive on a curve, showing a first and succeeding position

of two in., making a total of six in. Thus for the outer coil, $d = 1$ in., $r = 3.5$ in., $n = 9$ in. and $F = 6$ in.; and for the inner coil $d = \frac{5}{8}$ in., $r = 2.44$ in., $n = 15$ in. and $F = 6$ in. Substituting these values in the formula

$$T = \frac{FGd^4}{64nr^3}$$

we obtain for the outer coil, $T = 3{,}037$ lbs. and for the inner coil $T = 821$ lbs. The sum of these two, or 3,858 lbs. is the load on the spring when compressed. If the angle $t = 1$ deg. 30 min., then $T_1 = T \cos t = .9996\ T = 3{,}856$ lb. This shows that the force T_1 may be considered equal to T for all practical purposes.

Suppose the drawbar pull to be the nominal figure of 30,000 lbs. acting through a two-degree angle. Its side thrust, then, is $W_1 = W \tan 2\ deg. = .0349\ W = 1{,}047$ lbs.

Having calculated the resisting forces, let us next consider their moments. We obtain by solving right tri-

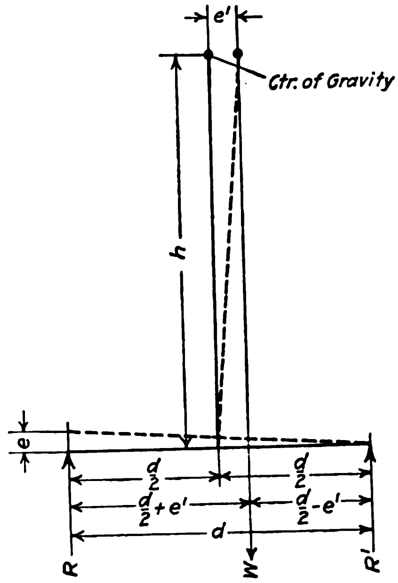


Fig. 6—Diagram showing the effect of the elevation of the outer rail

angles, the values for the diagonal distances given in Fig. 9. Using these values, and those for the other forces given in Fig. 9, we obtain the moments:

Driving wheel		In.-lb.
First outer	146.82 × 4,433 =	650,853
Second outer	89.94 × 4,394 =	395,196
Third outer	60.00 × 4,763 =	285,780
Fourth outer	89.94 × 4,700 =	422,718
Fifth outer	146.82 × 4,740 =	695,927
First inner	134.00 × 6,847 =	917,498
Second inner	67.00 × 6,786 =	454,662
Fourth inner	67.00 × 7,260 =	486,420
Fifth inner	134.00 × 7,320 =	980,880
Trailing truck spring	305.00 × 3,856 =	1,176,080
Draw bar pull	331.00 × 1,047 =	346,557
Total resisting moment		6,812,571

The next step will be to evaluate the overcoming reactions. If the leading truck weighs 3,500 lb., then the weight on the truck is 28,500 — 3,500 = 25,000 lb. Referring now to Fig. 7, if the distance from center to center of the rockers is 14 in., and the lateral movement of the bolster due to curvature is 4 in., then $r = 3$ in. and $s = 11$ in. From the formulas $Z_1 = \frac{Zs}{r+s}$ and $Z_2 = \frac{Zr}{r+s}$, we find these reactions to be 19,643 lb. and 5,357 lb. on the outer and inner rockers respectively. The angle z depends upon the design of the bolster, and is usually about 18 deg. The horizontal components of these vertical reactions are then $Y_1 = Z_1 \tan 18$ deg. $= 19{,}643 \times .3249$

= 6,382 lb. and $Y_2 = Z_2 \tan 18 \deg. = 5{,}357 \times .3249 =$ 1,740 lb. The total leading truck reaction is then $U =$ 6,382 + 1,740 = 8,122 lb., the lateral component of which is $U_1 = U \cos u$, which for a 1 deg. 30 min. angle gives $U_1 = 8{,}122 \times .9996 = 8{,}118$ lb., so that the effect of this angle may also be neglected in practice.

The reaction of the leading truck radius bar center pin may be computed from the formula $V = \frac{fOd}{a}$, in which f is the coefficient of friction, .20, O is the weight on the outer leading truck wheel, 11,200 lb., $d = 60$ in., as before and $a = 80$ in., from Fig. 9. Then $V = 1{,}680$ lb. and for a 1 deg. 30 min. angle v, its lateral component is $V_1 = V \cos v = .9996\ V = 1{,}679$ lb., from which it may also be seen that the effect of this angle may be neglected in actual work.

The trailing truck radius bar center pin reaction may likewise be found from the formula $R = \frac{dfO_6}{a^1}$, in which $d = 60$ in. as before, $f = .20$, the weight on the outer wheel being $O_6 = 22{,}990$ lb. and $a^1 = 89$ in. from Fig. 9. This gives $R = 3{,}100$ lb. with its lateral component $R_1 = R \cos r$, which for a 1 deg. 30 min. angle gives $R_1 = 3{,}100 \times .9996 = 3{,}099$ lb. showing that in this case too, R may be taken for R_1.

Using the moment arms given for these reactions in Fig. 9, we find the moments of these three reactions to be:

		In. lb.
Leading truck pivot................	166 × 1,679 =	278,714
Leading truck	246 × 8,118 =	2,098,028
Trailing truck pivot................	171 × 3,099 =	529,929
Total of all moments........................		2,906,671

The difference between this total moment and the total of the resisting moments must be taken care of by the flange of the leading driver, acting through the moment arm y, or 6,812,571 — 2,906,671 = 3,905,900 in. lb. for the leading flange. If the point of contact between the flange and the rail of this driver is 3 in. ahead of the

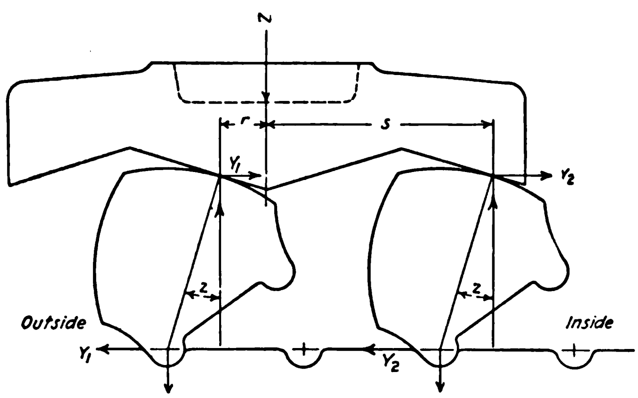


Fig. 7—Reactions in the leading truck

center of the wheel, then its moment arm is, referring to Fig. 9, 137 in. Dividing the otherwise unbalanced moment of 3,905,900 in. lb. by this arm gives 28,510 lb. as the thrust that must be produced by this flange.

Considering now the angle of incline, i, in Fig. 8 to be 80 deg., we find that the vertical component of this thrust of 28,510 lb. is $S_1 = S \cot i = 28{,}510 \times .1763 = 5{,}026$ lb. We also find that the pressure normal to the rail is $s = \frac{S}{\sin i} = \frac{28{,}510}{.9848} = 28{,}950$ lb. The vertical reaction of the friction due to this normal pressure is $s_1 = f^1 s \sin i$ = $.35 \times 28{,}950 \times .9848 = 9{,}978$ lb. The sum of these two vertical reactions, or 5,026 + 9,978 = 15,004 lb., must be overbalanced by the weight on the wheel if a derailment is not to result. Referring to the above computation of weights on the various wheels, we find that the outside leading driver exerts a load of 22,165 lb. on the rail, which is sufficient to hold the wheel down.

The factor of wheel bearing in this case is $\frac{22{,}165}{15{,}004}$ = 1.47, and as long as it is greater than 1.00, we do not need to fear trouble from the wheel climbing the rail. But .47 does not give very much of a margin and it is easy to see that it would not take very much variation in any

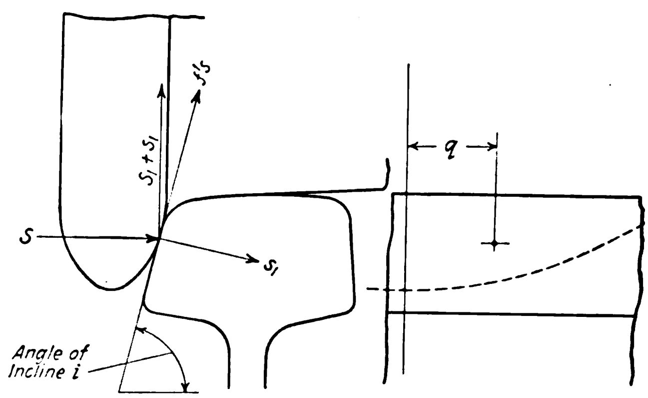


Fig. 8—Relation of the horizontal to the vertical forces at the wheel

one or more of the numerous conditions entering into this factor to bring it down to 1.00, or even lower, and thus cause a derailment. For example, a low joint may momentarily cause a reduction of weight on the leading driver—momentarily, yet just long enough to allow the wheel to climb the rail. A slight increase in elevation may do the same thing. A rail, out of line even for a short distance, may cause an added side thrust sufficient to do the trick. The locomotive may be just out of the shop, still somewhat stiff, and with the lateral taken up to the minimum, so that the binding action causes extra pressure and friction on the leading flange, the tires may still have their tool marks, which greatly increases the coefficient of friction. All of these factors tend to lower the wheel's advantage over the rail. These as well as many other conditions may be mentioned, which are contributory to the lowering of the factor of wheel bearing to the danger point of 1.00.

Benefits derived from this study

The value of a study such as this is not so much in setting forth the principles involved, or in being able ot calculate actual forces and stresses, or even in being able successfully to investigate cases of derailments and find the the causes thereof, as in being able to point out the conditions in the locomotive, track or operation which may be improved to prevent such derailments. The study is more of a means than an end in itself. So it would be well, in order to attain the desired end, to discuss some of the factors involved in the light of their effect on locomotive, track and operating conditions.

Locomotive conditions

Probably the locomotive condition which has the greatest effect in increasing the factor of wheel bearing is the lubrication of the leading flange. This lubrication makes a marked decrease in the coefficient f^1 with a proportional decrease in the vertical reaction s_1. All modern heavy

locomotives should have flange lubricators and in case of a derailment, the lubricators should be the first thing examined to see if they are working properly. Of next or nearly equal importance is the smoothness of the tire surface. We read of automobile tires that are geared to the road, and we get the same effect from locomotive tires that have finishing tool marks left on the tread due to chattering wheel lathes. A lathe should be powerful enough to take a finishing cut over the whole tread with a contour finishing tool without chattering. Of course tool marks soon wear off, yet the records show that many derailments take place with locomotives just out of the shop, on which the tires are not yet worn smooth. The pressure between the leading flange and the rail and its consequent vertical frictional and wedge reactions are not so great if the locomotive does not bind in the curve. There are several devices which may be employed to advantage in order to lessen or eliminate binding. The lateral or hub clearances may be increased on all the drivers or only on the front and rear hubs. This however, cannot be carried too far, on account of the I. C. C. limits for lateral, which require the wheels to be dropped, in case the lateral is too great. Yet the wear is greatest when the lateral is the least and even a little increase helps.

Setting the tires of the front and back wheels closer, back to back, than the others helps to lessen the binding. The use of blind tires on the main wheels, which has been assumed in this study, also helps. In addition to these remedies for binding there are also other devices, such as floating axles, which could be considered to advantage. But when such devices are used, they require a slightly different treatment of the problem of finding the factor of wheel bearing, due to the changed method of guiding, increased overhang of the leading truck, etc. It may also be observed that the coning of the treads of driving wheels has an effect on the situation. The coning soon wears off, but while it lasts, it does not act the way it should. By referring to Fig. 4 it will be seen that since the axles are held parallel to the frame and not radial to the curve, the fourth and fifth drivers have their large diameters rolling on the inner rail and their small diameters rolling on the outer rail. This is just the opposite from what we would like to have, with the result that the longitudinal slipping of the wheels is increased. The two leading drivers behave in the desired way, but since they are coupled to the others by the side rods, the effect of their good behavior is lost.

From the foregoing discussion, the benefit of the weight on the leading drivers and leading truck is apparent. These weights should be made as large as possible consistent with journal bearing pressures and rail loads. The driving wheel weight enters directly into the factor of wheel bearing and the leading truck weight enters directly into a guiding reaction which has a large moment arm and is therefore valuable. It may be observed from Fig. 7 and the discussion relating to it, that in curving an additional weight is thrown on the outer leading truck wheel, thus helping to increase its factor of wheel bearing and thus keep it on the rail. Sharp flanges are often blamed for derailments and sometimes justly, but in a case of this kind it would seem that they would be more advantageous than harmful. They increase the angle of the inclined plane between the flange and rail and thus lower the vertical force necessary to resist the side thrust. Long wheel bases, other things being equal, cause more binding in a given curve than short ones. Whether they would cause an increase in the factor of wheel bearing is something that would have to be determined for each case; for the moment arms of the resisting forces increase, at the same time the moment arms of the guiding reactions also increase, and an investigation would have to be made to determine if the one increased more than the other.

Mention has already been made of the resistance of the trailing trucks to curving, but these trucks become guiding trucks when backing, so that we can do no more than try to get a good compromise for the amount of their side thrust. The same is true of the leading trucks, except that the forward motion should be favored at the expense of the backward. While the effect of a booster on the trailing truck has not been taken into account in this study, such a device has a real bearing on the problem. For the traction of the booster has a lateral component which assists the curving of the locomotive by an outward thrust in forward motion.

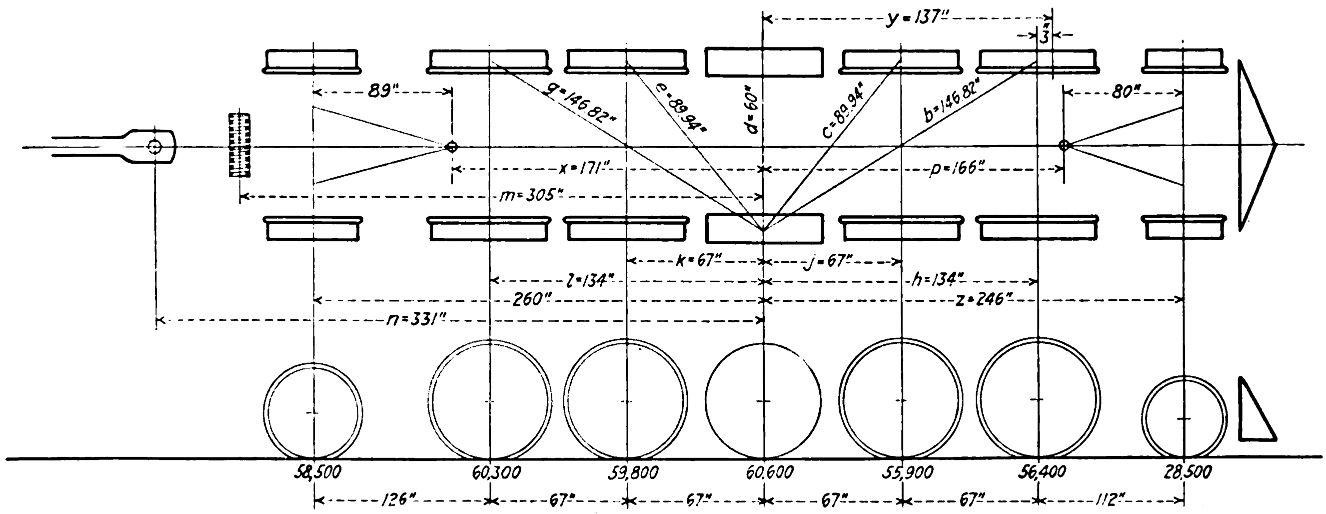


Fig. 9—The wheel loads and dimensions of a typical Santa Fe type locomotive

Track conditions

The track condition having the most important bearing on the problem is probably the elevation of the outer rail. Each locomotive requires a certain particular elevation for each speed and curvature so that, at best, any given elevation is a compromise. And since heavy locomotives require little elevation at low speeds this becomes the operating problem of running these locomotives faster or the fast trains slower, or by making a compromise to the end that the elevation may be reduced consistent with safe

operation of fast trains. The elevation operates at very slow speeds, as already shown, to relieve the outer rail of weight and to place it on the inner rail. Or, in the case given, the outer leading wheel carries 22,165 lb. and the inner leading wheel, 34,235 lb. for a four-inch elevation. Now if the elevation was increased so that the outer load of 22,165 lb. were reduced to 17,147 lb., which was found to be the vertical reaction, there would be nothing to prevent the wheel from climbing over the rail. Thus we see that rail elevation is a direct factor in the problem.

Next to elevation comes the matter of curve-worn rails. The worn surface simply provides the inclined plane up which the flange, if not restrained by weight, rolls to freedom. The more curve-worn the rail, the easier the ascent and the more difficult the work of holding the wheel down.

It would seem from this study that the track gage has little bearing on the problem, provided it is great enough to prevent binding, and in order to do this for Santa Fe type locomotives, it must be a little wider than standard on curves of eight degrees or more. Mention has already been made of track surface and alinement, and of the fact that variations in these, as well as in elevation, may cause momentary disturbances in the balance of forces sufficient to cause a derailment. The general use of spiral curves is helping to relieve locomotives of the sudden side thrust when entering a curve with the consequent sudden lowering of the factor of wheel bearing, thus making for the safer operation of heavy locomotives.

Operating conditions

While it has already been stated that any locomotive should be able to be operated at any reasonable speed over any curvature for which it is suitable, and that the locomotive and track conditions should be altered if necessary to make operation safe, yet it is profitable to see what effect operating conditions actually do have on the curving of locomotives. For example, it may be difficult to persuade a locomotive engineman to "widen on her" on a curve where he may have been on the ground the trip before, yet we must conclude from the study of the problem that an increase in speed helps reduce derailments, for not only does the coefficient of friction decrease with the speed, but also the effect of centrifugal force begins to be felt in helping to hold the outer wheel down. This deduction is borne out in practice. Locomotives that derailed at a particular place and a certain speed were found to traverse the place safely when the speed was increased. The use of steam and brakes also has some effect, for it has been found that locomotives will sometimes drift around a curve when, at slow speeds, the use of either steam or brakes would cause the wheels to tend to line up against the lateral, apparently increasing the binding and friction. Reference has already been made to the beneficial use of the booster on curves, the use of steam just mentioned not being intended to apply in the case of the booster. Reference has also been made to the reduction of the elevation which may be permitted by decreasing the speed of high-speed trains on curves that are giving trouble with heavy low-speed locomotives.

Summary

In order to grasp the situation as a whole, let us summarize the conditions which make curving easier and derailments fewer. In making changes, each of these conditions should be considered in the light of other related conditions, and the changes made should always be consistent with safety of operation and economical maintenance. These conditions are:

In the locomotive—
- Flange lubrication.
- Smooth tire and flange surfaces.
- Increase in hub clearance.
- Decrease in gage spacing of tires.
- Use of blind tires on main drivers.
- Use of floating axles.
- Decrease in coning of wheel treads.
- Increase of weight on the leading drivers and engine truck.
- Decrease of the trailing truck's side thrust.
- Increase of leading truck side thrust.

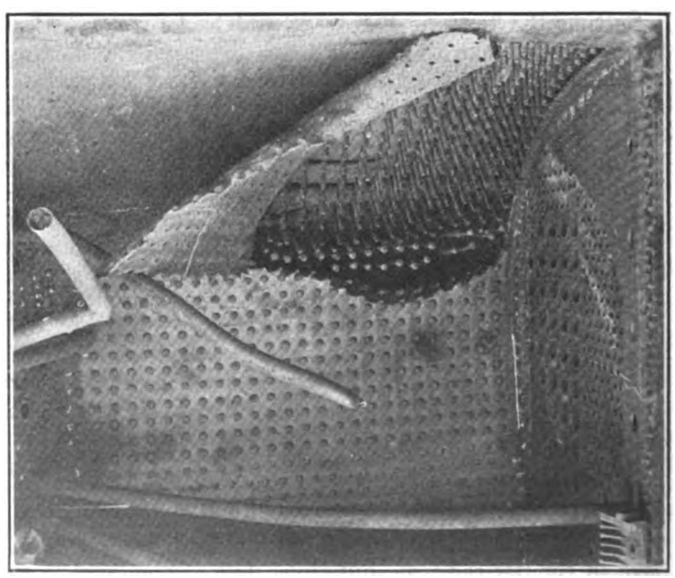
In the track—
- Decrease of the elevation of the outer rail consistent with the safety of high-speed trains.
- Removal of curve-worn rails.
- Maintenance of good service.
- Maintenance of good alinement.
- Widening of the gage on curves to prevent binding.

In operation—
- Judicious use of speed on curves.
- Drifting around curves.
- Use of booster on curves.
- Reduction in speed of high-speed trains to permit some elevation to be taken out of the track.

This method of analysis may also be used for the investigation of the factor of wheel bearing of the leading truck by assigning a calculated value to the side thrust of the leading driver and solving for the vertical reaction of the leading outside truck wheel. It may likewise be used for the investigation of derailments of either drivers or trailing truck wheels when the locomotive is running backward.

New Santa Fe locomotives for the C. N.

An article by C. E. Brooks, Chief of Motive Power, Canadian National, describing the new Santa Fe type locomotives recently purchased by that road, was published in the December, 1924, issue of the *Railway Mechanical Engineer*. It was stated in the title of this article that these locomotives were the largest of their type in the world. This statement is incorrect. While these locomotives are of exceptional weight and tractive force, there have been a number of others of the same type built which are of heavier weights and larger capacity, examples of which are those built for the Baltimore & Ohio and the Great Northern. The author of the article was not responsible for the incorrect statement.

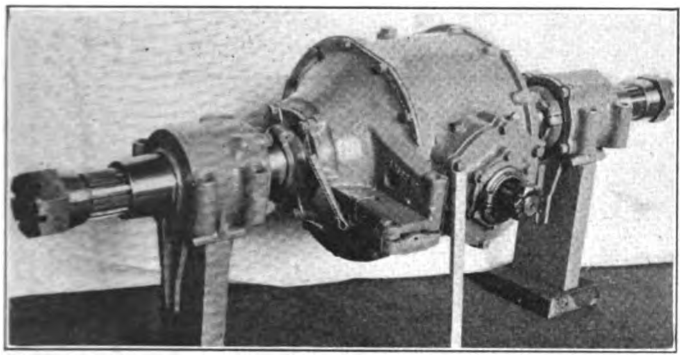


Failure of a portion of the flue sheet, crown sheet seam and side sheet seam which had been autogenously welded

Motor car of large capacity

Brill coach has seats for 59 and will haul a trailer seating 60 additional persons

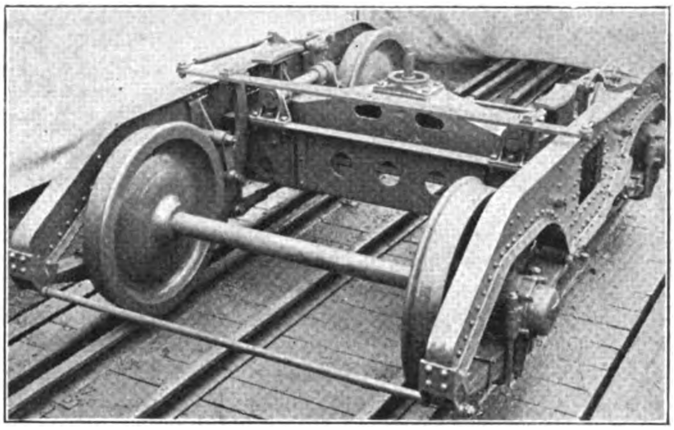
THE J. G. Brill Company, Philadelphia, Pa., has designed and built a large gasoline motor-driven passenger coach which has a maximum seating capacity of 59 and will haul a trailer with an additional seating capacity of 60. The car, designated by the builder as its Model 75, is driven by a six-cylinder motor which develops 190 hp. at 1,300 r.p.m., the power from which is delivered through a transmission of unique design to both axles of the forward truck. The motor is mounted at the forward end of the car body.



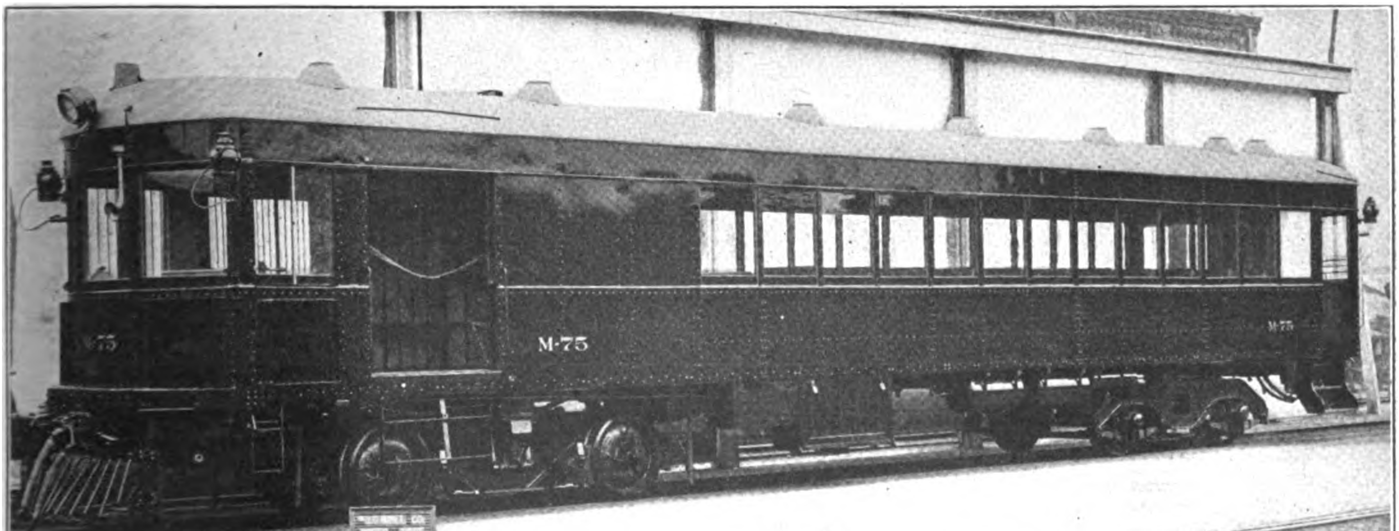
One of the axle gear cases, with the torsion spring seat showing at the left side

The transmission is of the drop shaft type. It was specially designed to take care of the powerful motor with which the car is equipped and is particularly noteworthy because of the fact that it is built into the bolster of the forward truck. One of the illustrations shows this bolster removed from the truck. The driving shaft from the engine is coupled through suitable universal and slip joints to the upper part of the two projecting shafts. This shaft is carried through the bolster and a shaft drive is taken off from the rear end for the operation of the air compressor. The lower of the two projecting shafts is connected at each end with a driving shaft leading to the gear case of the adjoining axle. This construction has materially reduced the normal angularity of the driving shaft from the engine and has practically eliminated the angularity from the shafts leading from the transmission to the axles.

This transmission provides five speed ratios, two of which involve the countershaft which is located at one side of the transmission output shaft. These two speeds are used only in starting and accelerating the car. For the remaining three speeds, the countershaft is idle and, as they operate at the same efficiency, each may be used as a running speed according to the requirements of grade and load conditions. The gears for the fourth and fifth speeds, the faces of which always maintain a fixed relation with each other, are of the spiral type. The gears for the lower three speeds, owing to the sliding relationship which must be maintained, are of the straight tooth type. All gears, however, are always in mesh, the changes being made by means of jaw clutches. Ball bearings are used throughout for all of the shafts and are also provided



The trailer truck

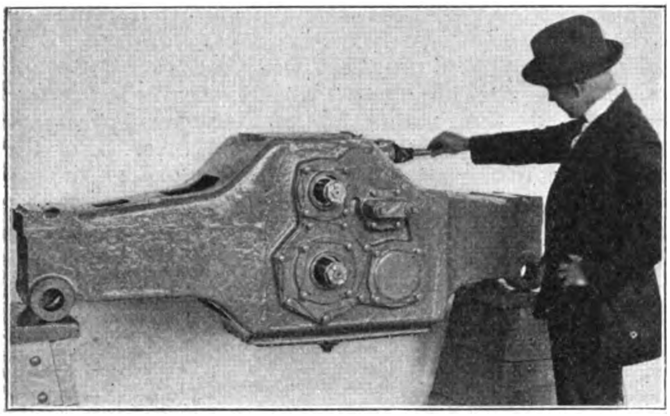


The Brill Model 75 motor car—length, 55 ft.; weight, 53,000 lb.; seating capacity, 59

between the driving shaft and the gears which run idle upon it.

The transmission always runs in one direction. The reverse is provided in the axle gear case, the bevel driving pinion meshing with two bevel gears, one or the other of which is connected to the shaft by a double clutch. The car may thus be operated with equal efficiency in either direction. The connections from the gear shift and reverse levers have been so designed that they compensate for the angularity of the trucks on curves.

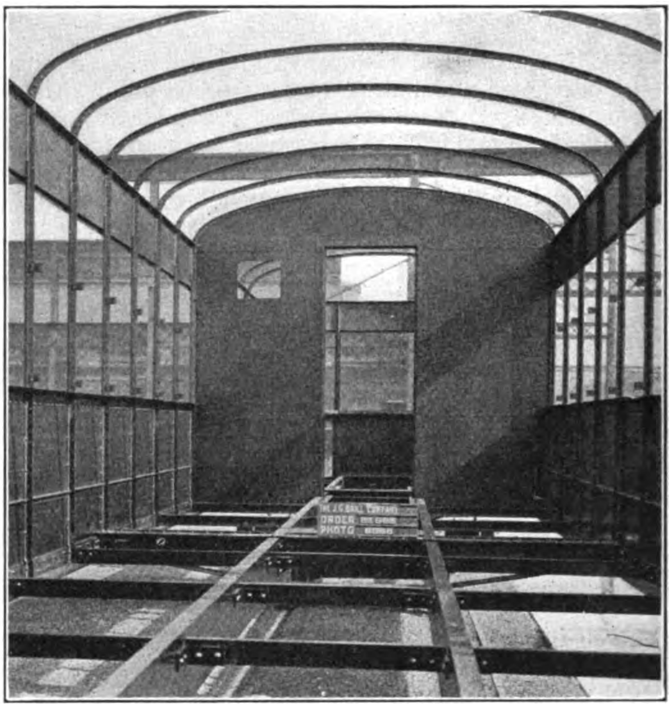
Both power and trailer trucks are generally similar in



The driving truck bolster—The figure is touching the gear shift arm

design. In the power truck, however, the side frames and journal boxes have been placed inside the wheels, while in the trailer truck they have been placed outside the wheels.

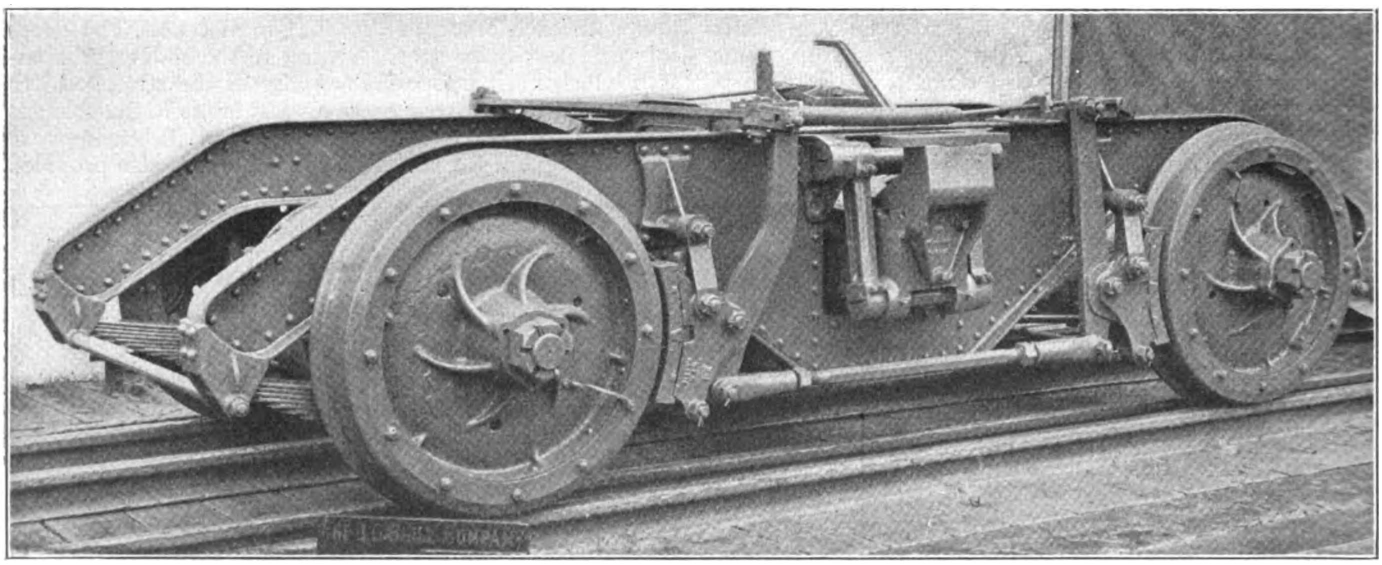
The side frames of both trucks are built up of double plates with the T-section flanges and fillers and stiffeners riveted between them. The axle suspension follows automotive practice in that the journal boxes are secured directly to the centers of the semi-elliptic springs. The bolsters of both trucks are supported on swing links. The on the end of the axle is drawn up. The torque is delivered to the wheels through a spline connection on the axle between the inner ends of the collets. This arrangement permits the wheels to be readily removed with a special puller when the removal of the axle from its gears becomes necessary. The axles are of heat treated alloy



The body and underframing of the Model 75 car

steel and are fitted with Timken taper roller bearings packed in grease. The wheels are of rolled steel, 33 in. in diameter, with M. C. B. flange and tread contour.

The motor is of the six-cylinder, four-cycle type, with 6-in. by 7-in. stroke. The size of the valves has been



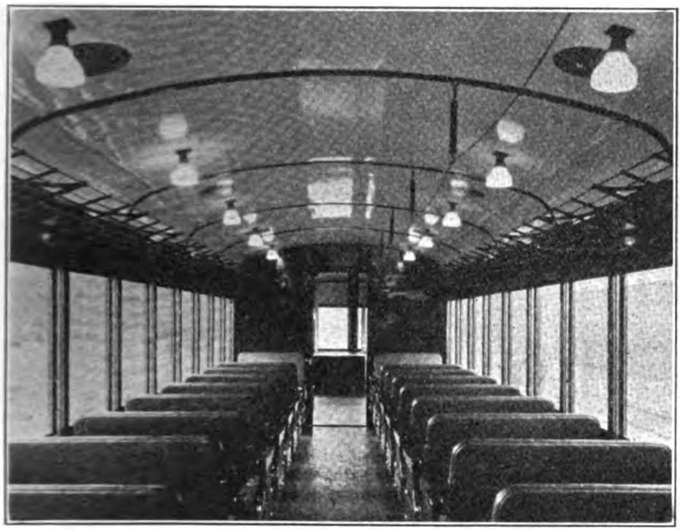
The driving truck with inside journals

links of the power truck are secured directly to the outside of the side frame, while those of the trailer truck are supported from the transom members.

The driving wheels are not pressed on the axles, but are secured by means of two taper collets which are securely clamped between the wheel fit and the axle when the nut kept down by using two intake and two exhaust valves for each cylinder. The engine develops a torque between 780 and 800 lb. ft. from a speed range of 500 r.p.m. to approximately 1,200 r.p.m., dropping off at higher speeds to approximately 740 lb. ft. at 1,500 r.p.m. The horsepower ranges from 75 at 500 r.p.m. to 150 at 1,000 r.p.m.;

190 at 1,300 r.p.m., and about 206 at 1,500 r.p.m. The fuel consumption per brake horsepower from 800 to 1,300 ranges between .5 and .6 lb. The engine drives through a multi-disk clutch of large diameter, fitted with a clutch brake which facilitates bringing the heavy driven parts into proper speed relationship for the operation of the gear shift. This clutch, the propeller shafts, the transmission and the axle gear housing, while developed along the lines of automotive practice, are of special designs larger than stock types, to take care of the heavy power transmission involved with minimum of maintenance or operating difficulty.

The engine is fitted with a starting motor operating



Interior of the coach, looking toward the baggage room

through a Bendix drive, a 12-volt generator of 1,000 watts capacity, two carburetors, two ignition systems, one a Delco distributer and the other an Eisemann high tension magneto, and a centrifugal pump driven water cooling system, the radiators of which are fitted in the front end walls of the car. All mechanical equipment involved in the driving of the car is included as a part either of the motor unit or the driving truck. Either or both of these units may be removed from the car and replaced within the duration of an ordinary lay-over period.

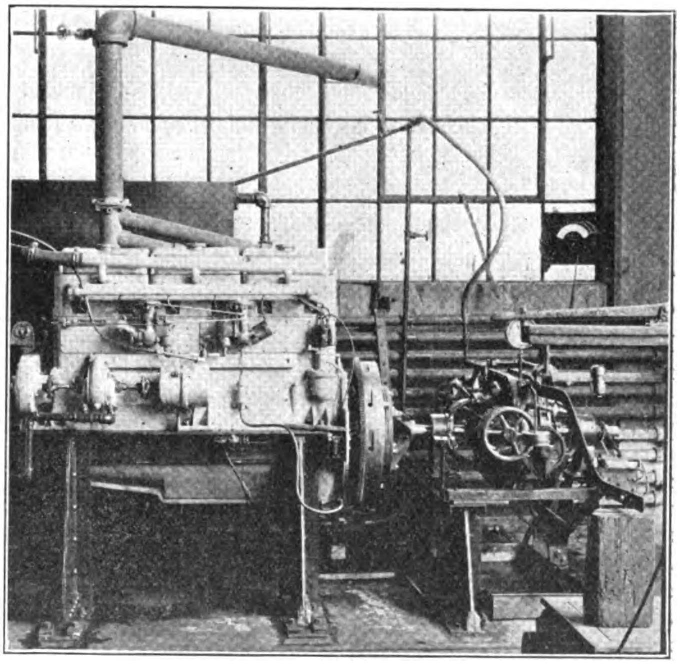
The car body is built to dimensions which closely conform to those of standard steam passenger equipment. The underframing consists of two 10-in. channel center sills which extend the entire length of the car body, angle side sills, built-up body bolsters, a diaphragm cross-tie at the center of the car and numerous floor supports. The body structure includes a frame of light T-section posts to which are riveted the outside steel side sheets and letter board. Carlines of sections similar to the posts support the roof, which is of wood covered with canvas embedded in white lead. The partitions between the baggage room and passenger compartment and between the passenger compartment and the vestibule at the rear are of steel plate riveted to a light weight framework of structural steel.

A feature of the inside finish of the car is the method of guiding and retaining the single bass window sash. This is accomplished by the use of Grill patented brass post casings which grip the sash with a sufficient spring action to prevent rattling. The sash are removed or replaced by springing back these casings and no removable window stops are required. These casings, designated by the trade name of Renitent, were primarily developed for use on street cars. The doors, casings and moldings are of dark stained mahogany, the ceilings are finished with Agasote and the side lining below the windows is of mahogany faced Haskelite ply wood.

The car body has a total length over ends of 55 ft. The baggage compartment, including the hood for the engine, is 16 ft. 3 in. The passenger compartment is approximately 34 ft. long and the rear vestibule is approximately 4 ft. long inside at the center. Access to the baggage room is obtained through 4-ft. door openings on either side of the car and the vestibule doors have a clear opening of 2 ft. 5⅝ in. The vestibule is entered by means of four steps on either side, the openings over which are closed by Edwards trap doors. The seats in the passenger compartment are furnished by the builder of the car. They are of the stationary type for two passengers each and have aisle arm rests. With this arrangement there is a clear aisle space of 30 in., which is large enough to permit the use of seats wide enough for three passengers on one side and two passengers on the other by using a type from which the isle arm rests are omitted.

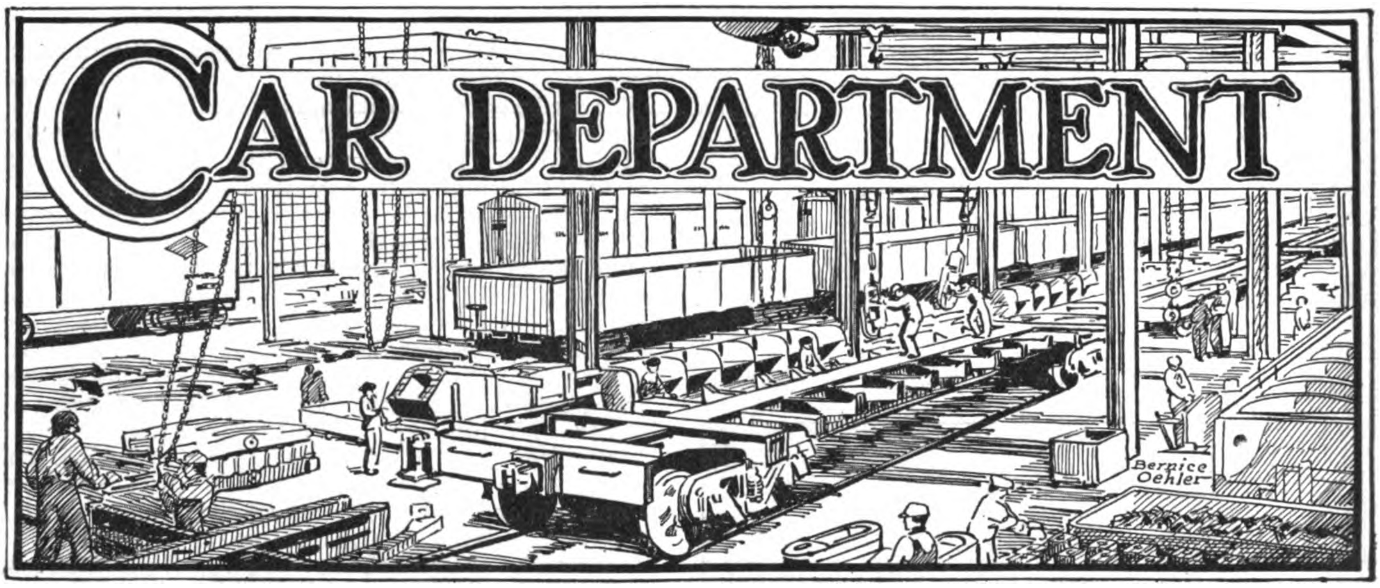
The interior photograph shows that the car is fitted with continuous parcel racks on each side of the passenger compartment and with 12 lights mounted on the ceiling, 6 along either side of the car. A saloon at the rear end is fitted with a dry hopper and a Giessel drinking water cooler. The car is heated by a Peter Smith hot water heater installed at the rear end of the baggage room.

On a trial trip recently made with this car, the car without trailer demonstrated its ability to accelerate up to 25 miles an hour at the rate of one mile per second.



The motor of the Brill Model 75 car on the testing block

Operating at the recommended engine speed of 1,300 r.p.m., the car develops a speed of approximately 59 miles an hour in high gear, 49 miles an hour in second gear, and approximately 24 miles an hour in third gear. As these three speeds are all direct drive, they are equally available for running and permit the handling of the trailer at the lowest of the three speeds on grades a little steeper than 1¾ per cent. Without the trailer it is calculated that the engine will be capable of maintaining the maximum speed in high gear on grades up to approximately 1 per cent and that it will maintain the lowest of the three direct drive speeds on grades of considerably over 3 per cent. The maximum speed may be maintained with a trailer on light grades up to about 0.35 per cent.



Improving car department service*

An interesting discussion of the methods which tend to make the "Milwaukee" car department an unusually effective organization

By L. K. Sillcox

General Superintendent of Motive Power, Chicago, Milwaukee & St. Paul, Chicago

Part I

SERVICE, such as implied in the title of this address, is dependent on an adequate organization, properly selected, adequately directed and constantly followed up. The elements involved are both human and material. In the first place, it is understood that each administration has its problems presented in a way peculiar to itself, so that any suggestions for change ought to be carefully weighed and, if found at all desirable, modified or improved upon to fit the actual condition in mind, then woven into the policies already obtaining, to the extent found most favorable to an enlargement and betterment of existing methods. Changes are hardly ever profitable, if hastily carried out; confusion and distrust are avoided if time is taken to consult with and receive suggestions from those directly affected.

A great deal of pressure is brought to bear from certain sections for even larger management units than we now have and yet the dangers of such a move are not often thought of and even less evidently expressed. There are those who urge more extensive railway grouping, those who feel that all of the freight cars in the country should be constructed, operated and maintained by one single organization and quite a number of other propositions similar in purpose, which are brought to attention from time to time. It is important in every circumstance where judgment must be passed to seek fundamental facts and principles. The aim should be, in any event, to preserve the personal equation and if large management groups can be so skillfully conducted as to meet this need, much of possible danger is avoided. Again, attention is directed to the thought that in any endeavor where individual initiative is lacking or conditions make the exercise of it unimportant, we are sure to travel in a negative direction. Competition is a necessity either in business or for a healthy sense of personal merit.

The one great thing that keeps the railroad service of our country to the present standard it has attained, even though some properties are not able to operate on a paying basis, is the element of attainment; still the public reaps the benefit. There is a fact to be reckoned with in our daily life as railroad men which cannot be expressed in dollars and cents. It is given freely, wholeheartedly and constantly—an ever living pride in the operation of the railroad each of us may be privileged to serve. I hesitate to bring so much data from the administration I am connected with, but if it is accepted as a few leaves from our book of experience and never in the sense of self-satisfaction, I shall feel some good has obtained. In addition let me say that such presentation as is made should be credited to the faithful support accorded by my associates.

Car design

It is necessary to adapt the question of car design to service (regardless of territory) with the object of having equipment which will give a maximum of return with a minimum of delay because of not being in the proper condition. The question of car design is ever progressing in that there is a rather constant advance in the methods of

*Abstract of a paper read at the regular monthly meeting of the Car Foremen's Association of Chicago, held December 8 at the Great Northern Hotel, Chicago.

operation as well as *universal* and *interchangeable* use, which must be kept pace with in the design of equipment. For the past 15 years there has been a considerable increase in the size and tractive force of locomotives in order to meet the demand for larger individual trains and thus reduce the unit cost of train and engine crew expense per ton mile. This has brought about a demand for freight equipment which will meet the changing conditions so that there has been a very marked enlargement in thought regarding the matter of strengthening parts, especially in the body bracing, underframing, draft members, etc. In common with other carriers our experience shows that these conditions generally develop into a demand for a plan of work or a program of improvements to freight cars such as will cause the major portion of ownership to be universally acceptable as to strength requirements and protect the owning road in current maintenance expense. For this purpose an analysis of the equipment owned with a view to determining that which has not been giving the proper service or which could not be brought up to operating demands is imperative and can usually be divided into:

(1) Those cars built of recent years which are of such design as to practically meet present conditions with maximum service.

(2) Those cars which have been built prior to the operating change referred to, but which could not be dismantled consistently because of age, general design and capacity and, therefore, which can be made subject to a special improvement program on the basis of a study of physical characteristics.

(3) Those cars which because of age, capacity, design and condition are not considered fit to be improved and, therefore, can be run until worn out and then dismantled.

The second item was found to embrace from 25 to 35 per cent of the total equipment in our case, and was affected by the policy of the carrier, for some 20 years previous, as to the rate of turnover in acquiring new and retiring old equipment.

Improvement program

It can be said, in general, where there has been a steady and accurate retirement program with an acquisition factor designed to offset the same, that it forms one of the easiest methods of overcoming obsolescence in design, but where retirements have been deferred with a consequent lack of new equipment acquired, the problem of overcoming obsolescence or the inherent design of equipment which does not permit of maximum service, is one involving large proportions and a great deal of expense when a change in policy is forced by reason of expanding service demands. Such a condition usually requires years to overcome. It is necessary to analyze each series of cars and determine what improvements or changes are required to make them fit for maximum service, then to work out a bill of material and labor schedule for each and determine the total cost. As a matter of convenience this plan is easily followed if each class of car is given a schedule number, the schedule representing the bill of material and amount of work to be done.

A program of this kind involves the selection of car shops best adapted to each kind of work with a corresponding organization of forces, stock of material, shop facilities, etc. The location of shops in the vicinity of loading stations is a factor of importance with respect to economy in transportation. Considerable supervision of such work is required to see that material is at hand to keep forces fully employed and that the work is done as prescribed and the output is at the proper rate. It is possible to set up a definite output based on a specific number of men allotted for the work at each point and then keep a definite record of the work done so that the

SCHEDULE REPAIR PROGRAM — PROGRESS REPORT — MONTH OF OCT. 1924

Schedule	Series	No. Cars Owned 1st of Month	Cars Retired During Mo.	Cars Owned end of Month	Total Cars Completely Overhauled to 1st of Mo.	Total Completely Overhauled This Mo.	Total Completely Overhauled to end of Mo.	Cars remaining to overhaul to end of Month	No. of Cars Covered by AFE to Completely Overhaul	No. of Live AFE	No. of Cars remaining to cover by AFE to be Complete Schedule
1	51900-68198	2476	None	2476)							
1	68300-69524	155	None	155)							
1	70526-72524	293	None	293)	4102	None	4102	None	4102	None	None
3	72526-81478	2948	4	2944	535	11	546	2395	1500	5624-8968-9685	1444
4	87484-93480	2888	None	2888)							
4A	81482-83480	947	None	947)							
4	500000-506204	6017	None	6017)	3355	61	3416	6436	6000	8966	3852
5	83482-87480	1860	None	1860)							
5	200000-206499	6084	None	6084)	6794	22	6816	1128	7948	7256	None
7	700000-703999	3989	None	3989	2	None	2	3987	None	None	3987
9	506205-508204	1968	None	1968	None	None	None	1968	None	None	1968
10	590000-590249	247	None	247	None	None	None	247	None	None	247
16	206501-207470	914	None	914	650	37	687	227	914	8251	None
23	735-2999	631	None	631)							
23	8149	1	None	1)							
23	8425	1	None	1)							
23	8267-12999	1059	None	1059)	None	1	1	1691	25	11395	1667
24	10000-102499	2354	None	2354	None	None	None	2354	None	None	2354
27	68695-68999	152	None	152)							
27	43001-45285	1073	None	1073)	None	None	None	1225	None	None	1225
27A	15001-15671	140	None	140)							
27A	26001-29675	757	None	757)							
27A	47401-47999	198	None	198)	None	None	None	1095	None	None	1095
29	32259-37257	2464	None	2464	None	None	None	2464	None	None	2464
31	29677-32075	1115	None	1115	None	None	None	1115	None	None	1115
32	300000-302499	2410	None	2410	1795	16	1811	599	2089	9918	321
34	25493-25891	169	None	169	169	None	169	None	169	None	None
39	48101-49999	693	None	693)							
39	70001-70969	348	None	348)	None	None	None	1041	None	None	1041
42	01-0767	418	None	418)							
	0879-01340	311	None	311)							
	01388-01453	39	None	39)	9	3	12	756	40	11647-12417	728
	Total C.M.&St.P.	45119	4	45115	17411	151	17562	28731	22787		23508

Fig. 1—Schedule repair program—progress report based on detail reports confined to location

status of same may be known at all times. An illustration of the manner in which it is possible to follow the general work, based on other reports of greater detail and confined to location, is given in Figs. 1 and 2.

In any such plan there is, of course, a great deal of heavy work done in the nature of repairs in kind and in many cases it can be determined by estimates before the work is done, whether or not it will constitute rebuilding as prescribed by an accounting method or will be considered as heavy repairs with certain charges to capital account for improvements. This is merely another expression of the fact that obsolescence is overcome to the degree that equipment when reinforced to meet present day strength requirements is accounted for in the books as new and the expected life cycle will be relatively extended. Freight car repairs, if carried on so as to give maximum car service at a minimum cost, usually result in dividing the work into two groups; that is, the repairs which must be made at certain frequent intervals to overcome wear of certain parts, and repairs which are naturally accumulated until the heavy repair cycle is at hand. All carriers renew, by force of circumstances, such items as wheels, axles, brake shoes, brasses, air-hose, couplers, etc., in their proper cycle between heavy repairs to the entire car. This is a natural sequence, if maximum service is to be obtained with a minimum repair cost and at the same time having the situation in control as to developments which require further improvements.

EXHIBIT NO. 1A

SCHEDULE WORK ON CARS

September 1924

C M & St P

Location	Schedule No. 3 Series: 72526-11478 Kind: Box No. Cars Owned 2948 Completed This Mo.	Schedule No. 4 Series: 87484-93460 500000-506204 Kind: Box No. Cars Owned 8905 Completed This Mo.	Schedule No. 4A Series: 81482-83460 Kind: Box No. Cars Owned 947 Completed This Mo.	Schedule No. 5 Series: [illegible]-87460 200000-200498 Kind: Box No. Cars Owned 7944 Completed This Mo.	Schedule No. 16 Series: 206591-207470 Kind: Auto No. Cars Owned 914 Completed This Mo.	Schedule No. 32 Series: 300000-302499 Kind: Gondola No. Cars Owned 2410 Completed This Mo.	Schedule No. 34 Series: 25495-25891 Kind: Ore No. Cars Owned 169 Completed This Mo.	Totals
Lines East								
Minneapolis	-	-	-	1	-	-	-	1
Chicago	-	-	-	-	-	6	-	6
Milwaukee	9	25	3	20	24	-	-	81
Dubuque	-	-	-	-	-	-	-	-
Green Bay	-	-	-	-	-	-	-	-
Total This Mo.	9	25	3	21	24	6	-	88
" to date	301	1388	*	4074	384	1695	169	8011
Lines West								
Deer Lodge	-	9	1	-	-	-	-	10
Tacoma	-	11	4	-	3	-	-	18
Total This Mo.	-	20	5	-	3	-	-	28
Total to date	234	1968	*	2720	269	100	-	5291
System								
Total This Mo.	9	45	8	21	27	6	-	116
Total to date	535	3356	*	6794	653	1795	169	13302
Total to be Overhauled	2413	6496	*	1150	261	615	-	10935

*Schedule 4 and 4A work being done on one A.F.E. Figures for Total Lines East Total West, Total System to date and total to be overhauled for schedule 4 includes Schedule 4A
#Total to date lines East, Schedule 5 and 32, includes 969 and 749 cars respectively, completed in contract shops.

C T H & E

Location	Schedule No. A Series: 2001-2999 8051-9150 Kind: Coal No. Cars Owned 1701 Completed This Mo.	Schedule No. B Series 6500-6999 Kind: Coal No. Cars Owned 445 Completed This Mo.	Schedule No. C Series: 11000-13180 Kind: Gondola No. Cars Owned 2114 Completed This Mo.	Schedule No. D Series: 7000-7899 Kind: Hopper No. Cars Owned 892 Completed This Mo.	Schedule No. 1-A Series: 101-350 Kind: Box No. Cars Owned 187 Completed This Mo.	Total
Terre Haute	3	-	25	-	-	28
West Clinton	-	-	-	-	-	-
Bedford	-	-	-	-	-	-
Chicago	-	-	-	-	-	-
Ill. Car & Mfg. Co.	-	-	-	-	-	-
Total This Mo.	3	-	25	-	-	28
Total to date	1624	440	638	887	-	3589
Total to be overhauled	77	5	1476	5	187	1750

BOX CARS

	40 ton box cars being converted to skeleton log flats at Tacoma.	40 ton box cars being converted to new ordinary log flats Milw. Shops
No. of cars completed to December 1st.	200	192
No. remaining to convert	50	58
	250	250

Office of Master Car Builder

Fig. 2—Monthly report of schedule repair work by stations

The turnover of equipment both in the matter of retirement, acquisition, rebuilding and heavy repair work is a very important feature in developing car repair programs and especially in determining the policy to be pursued after an analysis along this line has been made. For instance, the average age of equipment owned, while a vital factor in the proper knowledge of the repair situation, has not, for the most part, accurately reflected conditions as to requirements of policy with respect to physical factors on such roads as are subject to Interstate Commerce Commission accounting rules, as was the case prior to 1914. In that year the I. C. C. issued a classification of accounts, providing that the rebuilding of equipment in cases where the cost of the work constituted the major portion of the value be considered as renewed, and as this required calling equipment new under such circumstances, the life cycle was for this reason begun anew. This changed the situation considerably in the case of some administrations from their former practice, because prior to that time the life cycle of the car continued from the original date built regardless of the nature of the ensuing repairs or improvements and it was entirely optional with the owner whether or not it would be considered that cars were dismantled and used in building up new equipment or whether the original unit would be continued, as such, regardless of the work done. The requirements of the I. C. C. classification covering rebuilding made it possible for those who elected to do so to adopt a policy of refinancing and reconditioning equipment out of operating expenses in the first instance with a consequent adjustment of accounts and transfer of proper charges to capital account, all of which has generally been affected by the operating ratio as a determining factor in the extent to which the rebuilding of equipment could be carried out. In recent years, however, it has been found that other administrations have been able to borrow money on the new valuation of rebuilt equipment because, presumably, they could not bear the operating charge in the first place, even though this would eventually be credited to operating expenses and charged to capital.

Rebuilding programs must be carefully developed

The extent to which rebuilding and heavy repair work is carried on is very important. Heavy repair work can be reduced to a formula so far as requirements are concerned when an analysis is made of equipment to determine its physical characteristics on a broad scale and then set up the heavy repair cycles. These cycles run from 8 to 12 years, depending upon the characteristics of the

equipment. If a carrier owning 100,000 cars has had a turnover of rebuilding and heavy repairs at the rate of 10,000 cars per year, then it is apparent that the general overhauling cycle runs about 10 years. A more detailed analysis will doubtless develop certain cars requiring renewal cycles of eight years, others considerably more than that. The idea here is that a close regulation of the nature of repairs and, therefore, the general maintenance cost will finally resolve itself down to what is now being done in the case of locomotives, where there is a constant analysis required to determine the proper balance between running and classified repairs based on many considerations, one of which might be pointed out here as being the miles run out and miles restored in classified repairs. In the case of freight cars, years might be substituted for miles, considering years run out and years restored in overhauling. Much can be done along the lines of determining frequency of heavy repairs in further detail by records showing how this is progressing by types or series of cars. Returning again to the example of a road having 100.000 units, the following division is possible:

Cars		Age	
10,000	at	2 years	20,000
15,000	at	5 years	75,000
10,000	at	8 years	80,000
20,000	at	10 years	200,000
10,000	at	18 years	180,000
5,000	at	20 years	100,000
10,000	at	25 years	250,000
10,000	at	26 years	260,000
10,000	at	27 years	270,000
100,000			1,435,000

Average age, 14.35 years.

The policy of heavy repairs and rebuilding the past 10 years shows the average yearly number of cars so overhauled at 5,000 per year, or once every 20 years. The new program will require, after an analysis of equipment, an average of nine years between heavy work, so that the program will have to be increased to 11,111 cars per year, of which 5,000 will be rebuilt and thus renew the life cycle, and reduce the average age gradually to approximately 10 years, if the usual 20-year life is to be maintained.

But if an acquisition program is followed consistent with ownership, then there will be 5,000 cars retired and 5,000 new cars purchased, which will reduce the requirements for rebuilding to less than 11,111 cars, because of reducing the average age thereby. In the latter plan there will be an approach to the average age of 10 years but further analysis will be required to determine the extent of heavy work to be done to prevent the overhauling of obsolete cars to maintain the proper ownership complement.

Capital charges for rebuilt cars

It may be of interest to note further that the extent to which this kind of work can be transferred to capital charges is not always simply governed by the physical valuation in relation to capital investment, but as before stated, by the operating ratio, which is another way of stating that the amount of property required to perform the service is not, in every instance, the only factor, but the density of traffic as a whole or the volume handled which justifies building up capital out of operating expenses on the one hand, and direct capital charges by means of acquisition of new equipment on the other hand. Factors of this nature must be known and analyzed if a further and proper regulation of equipment is to be had consistent with local conditions, and any study will reveal the fact that at the present time there appears to be some difference in policy between carriers in this respect. Therefore, it is not possible to express specifically a general plan for common use. This is one of the reasons why the situation is not yet propitious for the central control of all the equipment in the country as a whole. Whether desirable or not, it will be many years before this problem can be fully solved and brought to a state of uniformity throughout the country. What makes this question of such great importance is that the maintenance of freight cars involves not only repairs, but includes charges for depreciation on the investment in existing cars and retirement charges (or deferred depreciation) involved in cars taken out of service. This is one of the cases in railway accounting where maintenance carries the burden of the investment, the only item eliminated being interest on investment, which is a fixed charge not included in maintenance.

While a schedule of improvements is an essential feature of any railroad policy in order to meet changing conditions in operation, there are other factors in the ordinary maintenance of equipment, such as painting programs, special attention to refrigerator equipment, repairs and inspection to permit selection of cars for specific loading, so that loads may move to destination without interruption, etc. In order to follow up a maintenance policy closely and have it regulated in accordance with what the revenues will permit, it is necessary to be able to decrease or increase special program work accordingly and also regulate other plans in maintenance policy such as inspection, light repairs, etc. [As an illustration of a rather close supervision of the various kinds of work at hand, Mr. Sillcox here presented quarterly freight and passenger car repair bulletins outlining the plan to be followed for three months and regulating the work to be done according to what conditions will permit.—EDITOR.]

Classification of inspection

Freight car inspection can be organized and classified so as to reduce the method of reporting thereof to a system rather complete in itself because carriers are not only concerned with their own repair policies, but must inspect both system and foreign cars for safe movement in trains whether the load originates on home or foreign lines.

In general, inspection may be divided between that required in the interchange of cars among railroads and that required to make the movement of trains safe over the handling line. Interchange inspection is standardized more or less under A.R.A. regulations, but it is within the province of the individual carrier to develop methods of freight train inspection with a view toward uninterrupted service. Some lines divide their freight train inspection into a number of groups, possible three classes, designated as numbers one, two and three, and have grouped their inspection forces accordingly, based on considerations of business demands and expenses.

The so-called inspection number one can be considered as that given to trains at larger originating terminals and to cover not only the condition of the equipment, but the manner in which the loads are to be placed and to enforce existing rules with the object in mind of having continuity of movement obtain. Inspectors at these points can be impressed with the importance of having loads in condition to move to destination without additional expense to shipper or carrier. Such inspection can cover the acceptance for service of all necessary items such as wheels, axles, journal packing, draft gear and brake rigging, body, trucks, etc. Special attention is often insisted upon to the body when cars are inspected initially to be placed for loading or for moving empty into territory originating freight subject to damage. This often involves the changing of wheels, etc., particularly in the case of stock cars before movement to loading territory. Close attention can also be given to safety appliances. An organization to carry out a plan as mentioned, can be

stated as consisting of two ground men, one roof man and two follow-up men, covering a string of cars from one end to the other, but when time is the ruling factor, two such gangs can be placed on one string, each working towards the middle from opposite ends. Such an organization may be provided for at terminals where there are approximately 2,000 loads and 900 empties or more moved each 24 hours. The organization for inspection depends upon the number of cars handled and the nature of traffic.

Inspection number two can be provided for at intermediate terminals at distances ranging from 150 to 300 miles from terminals where class one inspection is given. It may be applied at division points and smaller originating or interchange stations. The work covering the checking over for safe movement such items as wheels, axles, brake rigging, journal packing, draft rigging, safety appliances, air brakes, etc.

Class three inspection may be given to trains inbound or outbound at points after having received number two inspection at a distance of approximately 300 miles. The spacing of inspection stations, of course, depends upon the layout of the railroad. Inspectors can be stationed at points where they are in a position to observe trains moving into yard, looking for defects on wheels, brake connections, journal boxes, draft rigging and safety appliances. There should be a clear understanding in the matter of inspection as to what it means to "bad order" cars, and have them switched to repair tracks in cases where it would be possible to make repairs in the train yard. Switching is expensive and should be conserved, even though it is not charged to freight car repairs. Much can be done to save this expense and expedite the movement if handled in train yards.

While all that has been said relates to action which may be taken by car department employees, the element of possible loss to the service from lack of attention in avoiding cases of rough handling, cornering of cars, failure to release air brakes in making stops prior to taking siding for an opposing train, resulting in pulling out drawbars, and delaying both movements, etc., such losses may be avoided by proper co-operation and adequate appreciation in working out a plan in any given instance, for it is evident to most car men that losses of this character occur too frequently and that they are not sufficiently enumerated. A poor crew can generally manage to set out a few cars each day or burn off a journal occasionally, while it takes a wide awake and experienced train crew to treat boxes in such a way as to bring all of their cars safely into the terminal or save fuel in seeing that side doors on box cars, when picked up, are properly closed, not leaving the job entirely up to the other fellow or even overstraining themselves in these acts of constructive helpfulness. Laxity in practice has resulted from technicalities being applied, such as car men being called, in many cases unnecessarily, to couple hose, incurring expense entirely out of proportion to the work thus performed and which, for the most part, seemingly could not have been originally anticipated or even implied in the formulation of schedule rules. I recall a condition resulting from orders being issued requiring car men to scrub out cabooses which resulted in the men involved seeking information as to possibility of eventually being assigned to "redcap" duty in train yards. While the thought expressed may seem remote it clearly indicates the trend of mind on the part of car men who may be diligently applying their efforts in the interests of the service.

Qualifications and examination of inspectors

The requirements are that an applicant for a position of inspector must be thoroughly conversant with methods of car repair and construction, be between the ages of 21 and 45, must pass examination for sight and hearing, must be able to read and write, must answer 75 per cent of the 24 questions usually covered in the examination and, if he fails the first time, will be given only two more opportunities. The third failure disqualifies him. The examination papers are kept on file by the local car foreman. The questions usually comprise such items as inspector's duties, grouping of car parts so as to classify inspection accordingly, the functions of various car parts so as to establish the reasons for intensive inspection, questions as to loading rules and their requirements, safety appliances, air brakes, A. R. A. interchange rules, etc.

Air brake inspection

There are so many parts of equipment which require inspection and proper care to attain efficient service that it is not possible to concentrate too much on one particular item of inspection without neglecting the others, yet the inspection of air brake apparatus is one of the most important, not only as a matter of safety, but to reduce

Chicago, Milwaukee & St. Paul Ry. Co.
Air Brake Bulletin
March 15, 1924

Under this heading is published air brake news of interest, rulings and other matters. You are invited to raise any question on these bulletins, addressing them to James Elder, General Air-Brake Supervisor, Milwaukee,Wis.

Since the bulletins on "Piston Travel" and "Leverage" were issued, I have received a number of questions pertaining to brake beam hangers, such as, what effect does a vertical brake beam hanger have on the brake? What causes one wheel on a truck to slide? What is the correct angle for the brake beam hangers? etc. Instead of answering these questions through the medium of the "Question Box" I will endeavor to answer them in this Educational Bulletin.

When a train is in motion, the force applied to the brake shoe to bring each car to a stop is applied to the lower-most points of the truck, while the forces that are urging the truck forward are, first: the force due to motion applied at the center of gravity of the truck, and second: the force due to motion of the car body, which is applied to the truck at the center plate, far above the center of gravity. The rail pull holding the truck back while the car body surges ahead. This condition inevitably results in a tilting of the truck, with a reduction of the normal weight on the rear pair of wheels and a corresponding increase of weight on the forward pair of wheels of each truck. It will be quite clear that when the forces referred to are brought into existence by any application of the brake, the rear wheels of the rear truck will carry less weight than any other pair of wheels under the car.

A typical example of the bulletins issued periodically covering various subjects

losses incurred in dragging brakes, leaking air, etc. Much attention is given to this feature of the work because it requires mechanical precision and perfection. It is essential that definite maintenance regulations be established for work done on the repair tracks and shops and if this has been well established and systematized it is then a question of constant and proper inspection for service on the road. The training of inspectors for this class of work must be specific and in detail, note for example the air brake bulletin issued for March 15. Inspectors are directed to observe hand brakes, air and signal hose, piping, brake rigging clearances, couplings, piston travel and the necessity of cleaning brake cylinders and slack adjusters, dirt collectors, triple valves, retainers, etc., at proper intervals.

The period of service is closely checked to determine

the renewal requirements. Brake cylinders and reservoirs are inspected to see that they are kept tightly secured to the supports. The instructions as to adjusting brakes, piston travel, brake levers and other items of detail are set up specifically and fully systematized. When brake shoes are found to have a reddish color inspectors know that this indicates long application of brakes which usually heats the wheels and, therefore, requires a close wheel inspection as well, and an examination of the brake apparatus must be made in order to determine the cause of heating.

As to the inspection for cleaning air brakes, the A.R.A. rules are followed closely. Reports of cleaning are sent to a central office and when it is found that the same cleaning is necessary to be repeated within three months of the last date special investigation is made tracing back to the original point to determine the methods employed or the responsibility for lax work. A form (No. 665) showing the records kept by the general air brake supervisor on which is tabulated the work done at various points on the system, is illustrated on this page.

Wheel inspection

The inspection of wheels can be reduced to a specific and systematic arrangement and this plan is of great convenience. The organization of forces for intensive inspection of wheels should be specifically set up by localities.

We have found that practice desirable and efficient in the manner of placing responsibility not only for passing wheels in inspection which should have been removed, but preventing undue removal of wheels which should have continued in service. All wheels and axles removed are checked at specified points and on each axle is marked the symbol showing the nature of defects for which removal was made, giving the car initials, number, station and date. The system of symbols used is as shown below:

Symbol	Wheel defect
W 1	All right for service
W 2	Bracket cracked
W 3	Brake-burned
W 4	Burned from fire
W 5	Chill worn through
W 6	Flange broken
W 7	Flange chipped
W 8	Flange worn thin
W 9	Flange worn vertical
W 10	Hub burst
W 11	Hub worn
W 12	Large axle fit
W 13	Loose wheel
W 14	Plate cracked—front
W 15	Plate cracked—back
W 16	Rim broken
W 17	Rim chipped
W 18	Seamy
W 19	Shelled out
W 20	Shoulder worn
W 21	Slid flat
W 22	Tread cracked
W 23	Tread worn out
W 24	Wheel broken
W 25	Wheel condemned by remounting gage

Other reports are rendered to show wheels pressed off, mounted, gage readings, etc., with a complete record by wheel numbers. Axles are classified in somewhat the same manner as wheels to cover defects. [The final installment of this paper will appear in an early issue of the *Railway Mechanical Engineer*.—EDITOR.]

Form 665 Revised
Chicago, Milwaukee & St. Paul R.R.Co., Car Department
Repairing and cleaning air brake apparatus

________________ 192 _____

Mr. James Elder,
Gen. Air Brake Supvr.,
Milwaukee Shops.

Following is report of air brake work performed at __________ for the month of _________ 192__, in freight and coach yards, transfer, house and repair tracks:

	Passenger		Freight	
	Sys'm	For'n	Sys'm	For'n
1. Number of brake cylinders cleaned having last cleaning date less than 9 mo. frt., 6 mo. pass.				
2. Number of brake cylinders cleaned having last cleaning date from 9 to 12 mo. frt.				
3. Number of brake cylinders cleaned that had not been cleaned within 12 mo. frt. 6 mo. pass.				
4. Number of cylinder packings renewed				
5. Number of cars having brakes tested with air pressure while on repair tracks				
6. Number of air hose applied				
7. Number of angle cocks removed and exch.				
8. Number of retaining valves cleaned Number of retaining valves exchanged				
9. Number of freight cars repaired and delivered off repair track during month as shown on bad order report				
10. Number of slack adjusters cleaned				
11. Number of passenger triple valves changed				
12.				
Work performed in triple valve and air brake shops				
13. Number of triple valves passing final test over A.R.A. test rack				
14. Number of triple valves having repairs made to slide or graduating valves, piston ring or bushing				
15. Number of air hose mounted and tested under air pressure				
16. Number of angle cocks repaired				
17. Number of retaining valves repaired				
18.				

Whenever necessary to re-clean brake equipment, passenger or freight as per rule 60 due to being inoperative in less than 3 mo., car initial, number, last place and date of cleaning, also cause for brakes being inoperative to be shown below.

Record of incoming and outgoing air brake inspection of freight trains	Passenger		Freight	
	Sys'm	For'n	Sys'm	For'n
19. Number of arriving trains on which incoming test was made				
20. Number of arriving trains having less than 85 per cent effective brakes				
21. Number of cars set out for repair tracks due to inoperative brakes (brakes sticking or old air dates not considered)				
22. Number of cars set out due to old air dates				
23. Number of defective air hose replaced				
24. Number of cars with improper piston travel which were corrected				
25. Number of cars set out for damaged wheels or burnt brake shoes due to defective air brakes				

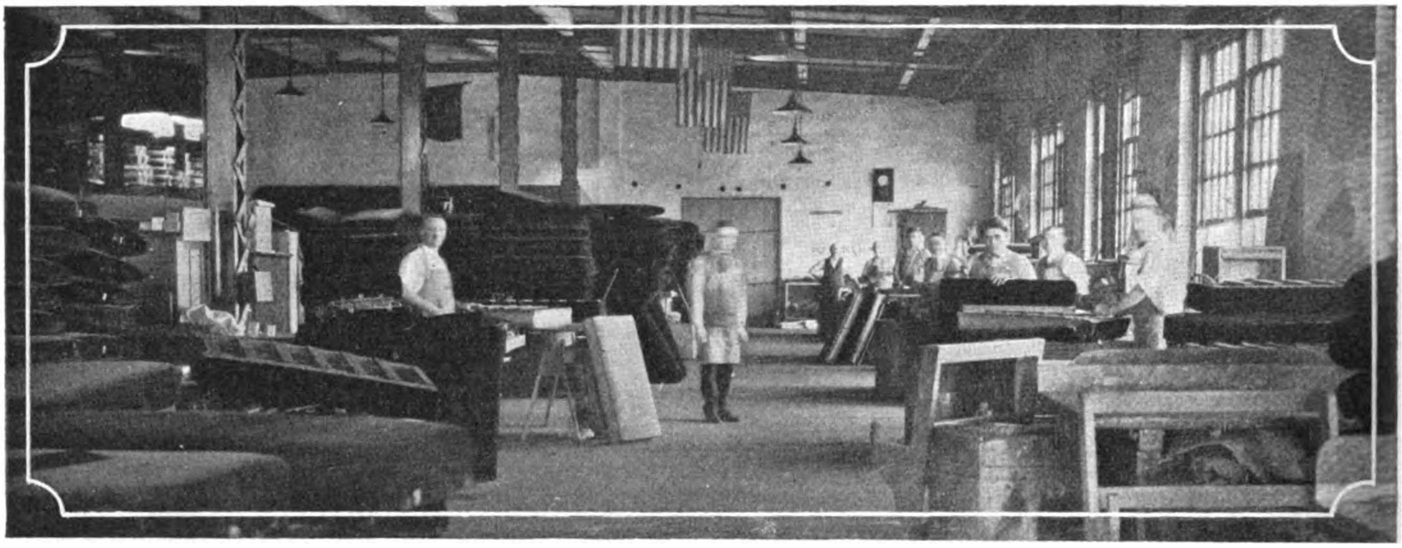
Record of cars found necessary to re-clean before being 3 mo. in service

Date	: Number and Initials :	Kind of triple	Last place and date of cleaning	Remarks

Checked by ________________ Foreman

Report of air brake equipment cleaned and repaired

THE MISSOURI PACIFIC has adopted a plan in its mechanical department whereby employees are invited to make suggestions to bring about greater efficiency and convenience in doing their work. Boxes are installed in the departments and blanks are provided for the employees. The suggestions are acted upon by two committees, one a production committee composed entirely of employees and an executive committee composed of three employees, the superintendent and the production engineer. The production committee first considers all suggestions, and, if they are considered worth adoption, passes them to the executive committee.



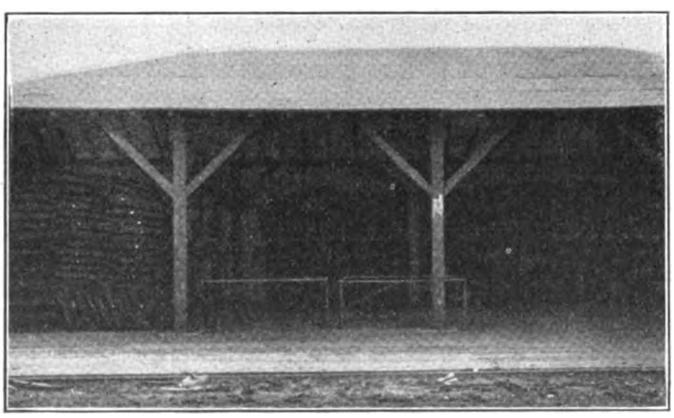
General view of the upholstering department at the North Billerica Shops of the Boston & Maine

Renovating interior trimmings of passenger cars

Proper location of tools and equipment has made possible the repair of upholstering by the progressive system

Part I

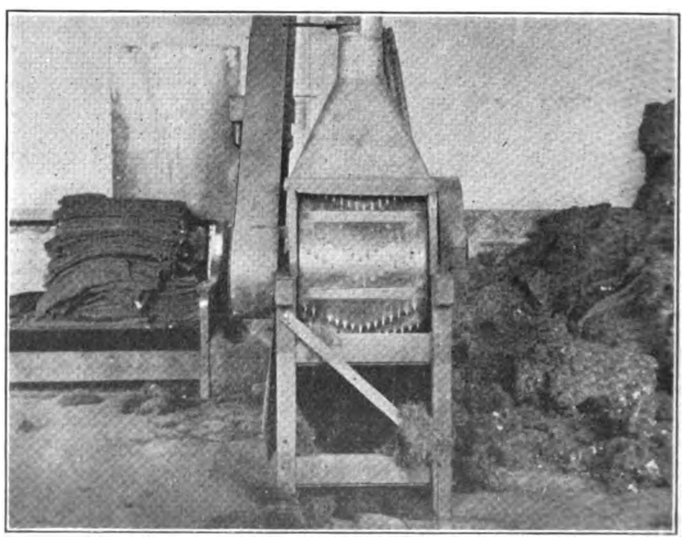
WHEN laying out the car department for the North Billerica shops of the Boston & Maine, considerable thought and careful planning was devoted to the upholstering and lacquering departments. These departments were planned and equipped to handle all of the interior trimmings of passenger cars on the system. The interior trimmings of from four to five cars are renovated



Shed where dust is blown from car seats and window blinds before they are taken to the cleaning room

in these departments every eight hour working day by a total working force of 25 men. In order to maintain this schedule, the work is routed through the departments, especially the upholstery shop, so that it will progress from one operation to the other in the same direction, thus eliminating any unnecessary handling of the work. The proper location of tools and equipment has made possible this system of progressive repairs.

The lacquering department has adopted the most modern methods available for cleaning and plating metal trimmings.



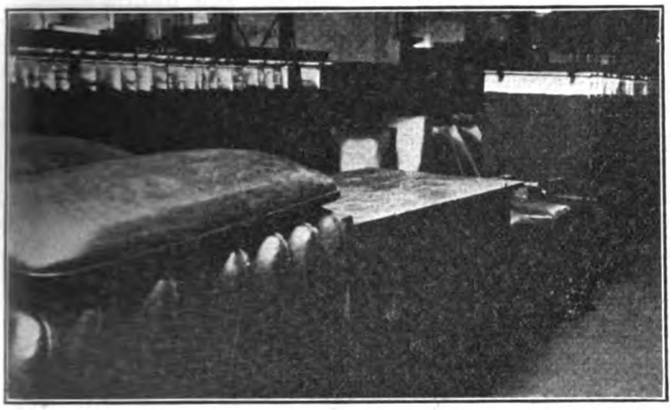
Machine for shredding hair used in car seats

The acid, washing and plating tanks are located in such a manner so as to insure a minimum lost motion in handling the work from one process to the other. Considerable study has been given to the protection of the workmen against the poisonous fumes of the chemicals used. The fumes are

carried away by a suction draft system leading from each acid containing vat.

The upholstering department

The upholstery and lacquer departments are located on the second floor of the paint shop which is in the same building in which the passenger cars are repaired. All the work is brought up to these departments on a freight elevator

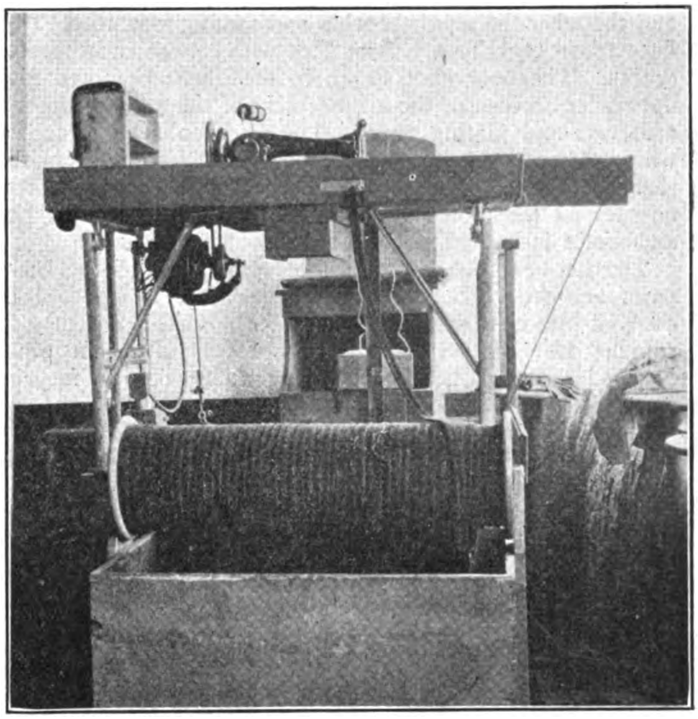


Pantasote seats and window blinds drying after receiving final coat of Imperial renovator

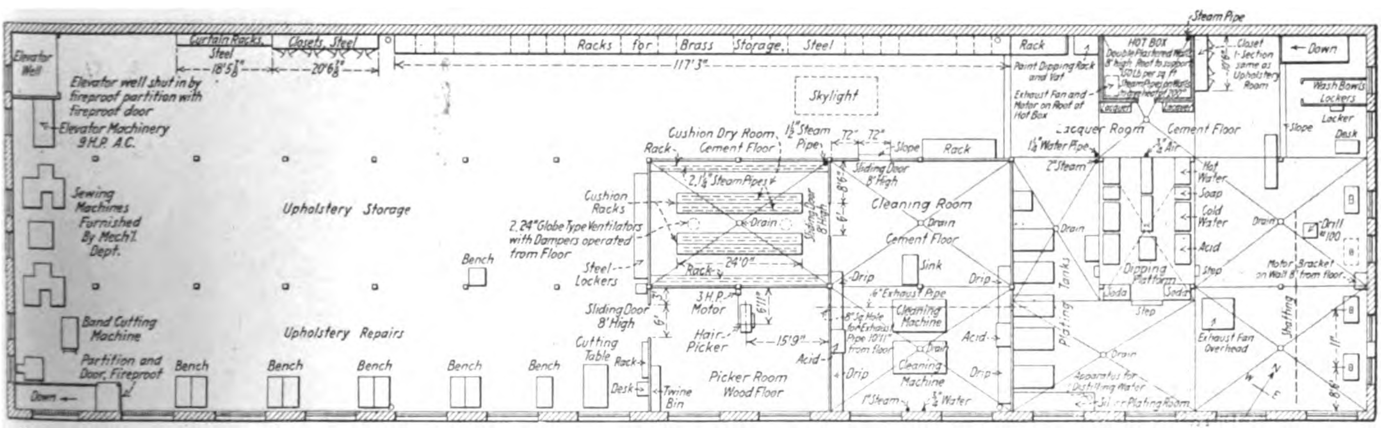
which is convenient to the shed where the dust is blown from the window blinds, seats and backs.

Located at the rear of the upholstery shop are the cleaning, drying and hair picking rooms. At the front of the shop are the repair benches, sewing machines and upholstery storage space. With this arrangement, the car seats and window blinds enter the cleaning room and pass in one direction through the various processes of renovation until they are complete, when they are either taken direct to the car for which they are intended or are placed in storage until needed.

The cleaning room is a large, well lighted room containing a cement floor properly sloped so that the water will run into two drains. On each side of the room, next to the wall and close to the windows is a sink with two sloping drip boards. These are used for washing and dyeing the plush seats. Another sink is located approximately in the center of the room which is used for washing by hand the window blinds and Pantasote seats. Cleaning machines are located between the two sinks for cleansing the plush seats. The two principal parts of these machines are the table and the swinging, revolving brush. The table is mounted on a movable carriage which can be moved back and forth, parallel to the center line of the brush spindle. The table has a motion transverse to the movement of the carriage. It has a vertical adjustment to take care of the various sizes of seats and the wear of the fiber brush, which is motor



Two-needle sewing machine with a special attachment for inserting two strands of No. 60 twine in binding for car seats and backs



Layout of the North Billerica upholstery and lacquer shops

driven and can be swung back and forth over the work on the table.

The drying room for the cushions is entered directly from the cleaning room. It contains six racks which have sufficient capacity to hold the seats and backs of five cars. Each rack has two 1¼-in. steam pipes passing through it. In the floor between the two main racks are located two 24-in. globe type ventilators with dampers. When in operation, this room is shut off from the cleaning room by a 6-ft. by 8-ft. sliding insulated steel door.

Next to the drying room is the hair picking room which is entered from the upholstering department. In this room is located a hair picking machine which separates the hair after it has been washed. The machine consists of a belt driven drum containing shredding teeth. The dust and fine

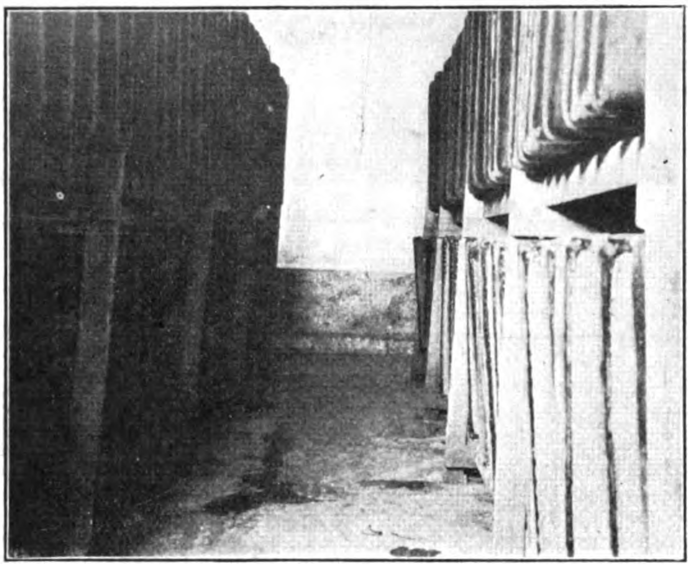
hair is carried off through a hood located over the drum.

The lacquer room

The lacquer or brass renovating room is practically divided into two sections, one containing the chemical vats and the other the repair benches and buffing machines. This department contains a cement floor with conveniently located drains. The floor plan shown in the illustration will give the reader an idea of the arrangement of the various wooden acid vats and plating tanks. The acid tanks are provided with exhaust pipes to carry off the gases coming from the chemicals used. The piping for this exhaust system terminates on the roof of the hot-box where the exhaust fan and motor is located.

The hot-box referred to is the room in which the brass parts are dried after being lacquered. It is enclosed in doubled plastered walls 8 ft. high. The roof is designed to support 150 lb. per sq. in. By means of steam pipes fastened to the walls, a temperature of 200 deg. F. may be obtained.

Located next to the west wall of the hot-box is the paint vat, in which car gates, locomotive headlight casings, car hand brake levers, etc., are dipped. The vat and its lid are made from sheet steel riveted together. Running from it is an inclined trough over which runs a monorail supporting a number of trolleys which are used for hanging the painted parts on so that they may thoroughly drip off before being placed in the hot-box.



Interior view of the drying room showing method of drying car seats and backs

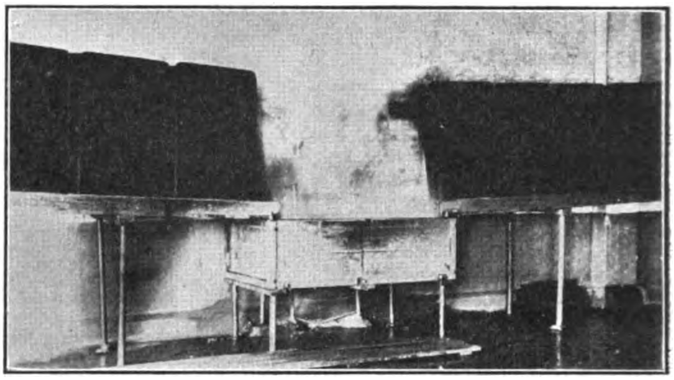
The silver plating room is located at the southwest corner of the lacquer room. This room is completely partitioned off from the rest of the department by a heavy wire screen. In this room are the silver plating tanks, assay scales under glass, an apparatus for distilling water and a heavy safe in which the bar silver is kept. The still is used to supply water for the Boston & Maine system. When the silvering tanks are not in use, they are covered over to keep foreign matter from the silvering solution.

Renovating car cushions and window blinds

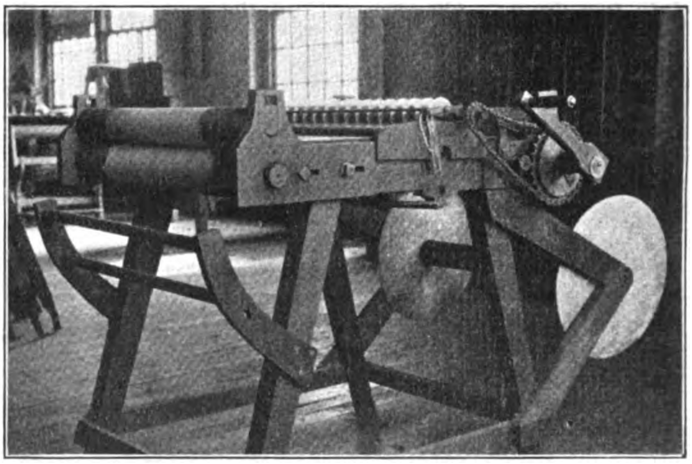
Before the passenger cars are placed on the repair tracks in the shop, the interior trimmings are removed. The metal fixtures and trimmings are taken direct to the lacquer room while the window blinds and the seats and backs are hauled on four wheel trucks to the blowing-off shed located at the southwest end of the paint shop. This shed, shown in the illustration, is entirely closed on two sides and partially on the side next to the paint shop. It contains two racks made from pipe, on which the cushions are placed while the dust is being removed. At a convenient distance from these racks are two air pipe outlets to which are attached suitable air hose for cleaning purposes. With this arrangement, the loose dust and dirt is thoroughly blown from the cushions and window blinds.

Cleaning the cushions and blinds

The cushions and blinds are then taken to the cleaning room. Here they are cleaned by the French Renovating Company's plush renewing process. Forty gallons of warm water is run into the cleaning sink to which is added one bottle of French cleaner. This amount will clean the seats and backs for one car, or a total of 76 pieces. They are thoroughly soaked in the cleaning solution and then placed on the sloping drip boards to drain off. They are then placed on the cleaning table shown in the illustration where they are thoroughly cleaned by the fibre brush which revolves at a speed of 1,700 r.p.m. This removes all dirt, soot and grease, so that the dye, which is next applied, may penetrate the fibre of the fabric. If the dirt were not thoroughly removed, before the application of the dye, both the dirt and the dye would be removed on the clothing of passengers after the cars were again placed in service. This process also thoroughly disinfects the cushions.



Plush seats draining off after being dipped in the dye solution



Hand operated machine with 15 circular knives for cutting plush cloth into strips for seat binding

The dye solution is prepared in a vat directly across from the cleaning sink. The cushions are again dipped and allowed to drain off, after which they are placed in the drying room. They remain in this room over night and then are taken to the repair benches.

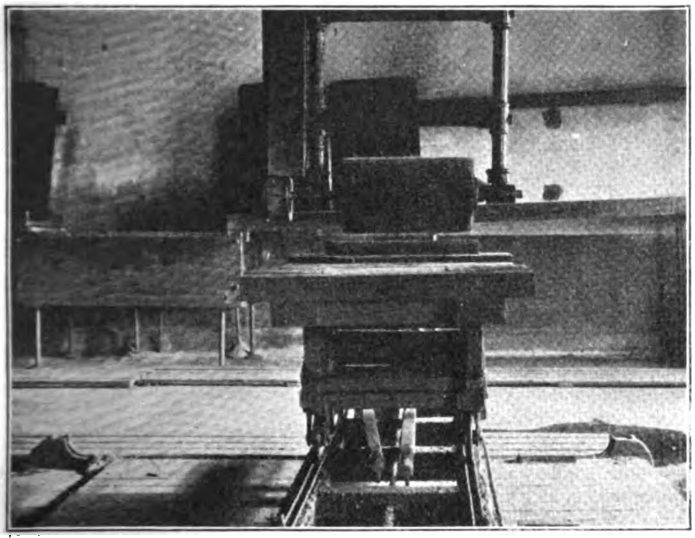
Pantosote seats and window blinds are scrubbed by hand with soap and water. They are then placed in the drying room, after which the Imperial renovator is applied by hand which leaves a dull finish. After the blinds are painted, they are hung on a specially designed rack to dry as shown in the illustration. The Pantosote seats are placed to dry in rows on the floor.

The cushions and blinds are cleaned on a piece work basis. One man can clean in a day the cushions from three cars while two men can clean those from five to six cars.

How repairs are made

After the seats and curtains are cleaned, they are given minor repairs or completely rebuilt. Such defects as worn or torn plush, burlap covering over the springs giving away, broken or worn out springs or a broken wooden frame keep the repairmen busy. When a seat is completely overhauled the hair contained in it is passed through the hair picking machine shown in the illustration, which tears it apart and restores its fluffy condition.

An interesting operation in connection with repairing the seats, is the method of making the plush binding which goes around the edge of the seats. Plush cloth 28 in. wide is



Machine for cleaning plush seats and backs after they have been dipped in the cleaning solution

passed through a hand operated machine containing 15 evenly spaced circular knife blades which cut the plush into strips 1⅞ in. wide. The machine shown in the illustration is mounted on a wooden frame which has at each end a set of wooden rollers, covered with sand paper, for the purpose of pulling the cloth through the machine. The trunnions of the upper roll run in rectangular slots. On the trunnions are wooden caps upon which are placed a spring which allows the top roll to be opened in order to start the plush through the machine. These springs also serve the purpose of compressing the top roll on the plush so that the abrasive paper will grip the cloth. The arbor holding the cutting blades is turned by means of a hand operated sprocket wheel and chain. The blades may be readily removed for sharpening.

The ends of the strips are sewed together and are then ready for the following operation. The plush band is sewed in a two needle motor driven sewing machine placed on a suitable table which is mounted on a raised platform on which the operator sits. The plush strip is contained in a box underneath the platform and is fed up to the machine. The illustration of this machine shows two balls of No. 60 twine leading up to the needles of the machine. This is fed through a special attachment which forms the double beading of the plush band. The band measures ⅞ in. wide when finished. These two machines, along with additional sewing machines and cutting tables, are located at the west end of the shop. On these machines the window blinds are repaired or new blinds made to replace the old ones. In this shop are made all the blinds for the Boston & Maine system.

The operations in the lacquering department will be described in the concluding part of this article, in the January issue.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Repairs occasioned by one shopping not consolidated in same bill

Maine Central car No. 3763 was shopped by the Boston & Maine at the East Fitchburg, Mass., shops on December 12, 1922; a wheel change having been made and also two journal bearings applied on that date, charges for which were included in the January, 1923, bill, supported by the proper billing repair cards. Other repairs were made and charges included in the February, 1923, bill, also supported by the proper billing repair cards.

The Maine Central claimed that the Boston & Maine should have withheld the bill for the wheel change until such time as the bill for the balance of the repairs to the car were completed and the two bills consolidated to reach that company as a complete charge for repairs to the car in accordance with Rule 93. The Boston & Maine claimed that Rule 93 did not cover the case in question, its interpretation of the rule being that one single bill must be made each month, but that the rule does not require all of the repairs made to a car to be included in the same bill. The contention was that, inasmuch as the repairs were continuous and the car was not released for service until all repairs were completed, the fact that part of the expense of repairs were included in the month of January and the balance of the repairs in February, in no way released the Maine Central from its obligation to pay the bill presented in the February, 1923, account.

The Arbitration Committee in rendering a decision in this case, stated that: "It is important that all proper charges for repairs occasioned by the same shopping of the car be consolidated in the monthly bill to enable proper check of all charges, overlapping labor items, etc. The circumstances in this case, however, do not justify cancellation of the subsequent charge. This decision has no bearing on previous decisions with reference to charges omitted, reopening accounts, etc."—*Case No.* 1314, *Maine Central vs. Boston & Maine.*

Charges rendered on authority of defect card

The Southern Pacific removed one pair of cast iron wheels from El Paso & South Western car No. 20369 on account of one wheel being loose on the axle, and applied one pair of new rolled steel wheels which were standard to the car. A bill was rendered against the car owners on authority of copy of defect card issued by the Chicago, Rock Island & Pacific and billing repair card, the charges for wheel centers and service metal of the steel wheels being based upon A. R. A. Rules 98 and 101, effective February 21, 1922, the date of the defect card, instead of the rules as changed by Supplement No. 1 to

the 1921 Rules, effective May 1, 1922. The Chicago, Rock Island & Pacific had removed a pair of steel wheels from this car and applied a pair of cast iron wheels. Credit was allowed the car owner for the difference in value of the wheels applied and those removed and defect card was issued as required by the rules. The car owner contended that the defect card authorized A. R. A. prices at the time the defect card was issued only for such items as the defect card authorized the car owner to bill the company that made the improper repairs. It further contended that the repairs were not made by the Southern Pacific on account of improper repairs, but on account of the car owner's defect in accordance with Rule 81, and that the billing repair card and Rule 98, not the defect card, authorized the charge against the car owners for wheel centers and service metal. The steel wheels applied should have been furnished at current A.R.A. prices as under Rule 98, the defect card being only for the protection of the car owner. The Southern Pacific maintained that the defect card was its only authority for a charge against the car owner under Rule 98 and that if, therefore, the defect card actually performed such function, it was entitled to charge prices in effect at the date of the card or at the same rates as credit allowed by the Chicago, Rock Island & Pacific when making the wrong repairs. The Southern Pacific further stated that the principle that the date of the defect card governs has been so long established, that railroads have not questioned it in recent years.

The Arbitration Committee rendered a decision sustaining the contention of the Southern Pacific and referred to the decision rendered in connection with case No. 1273.—*Case No.* 1316, *El Paso & South Western vs. Southern Pacific.*

Car and engine replacer clamp

FREQUENTLY a car and engine replacer will not stay in position when the wheel is being moved up and onto the rail. The clamp shown in Fig. 1 has been designed to overcome this difficulty. Holes for the clamp

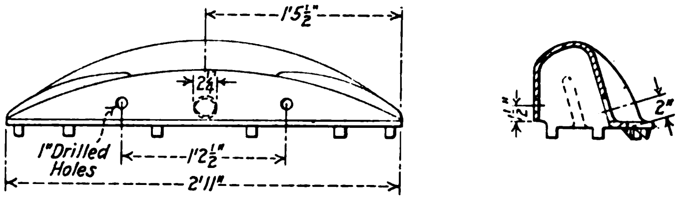


Fig. 2—Drawing showing the location of the holes in the replacer for the clamp

are drilled in the replacer as shown in Fig. 2. The clamp is made in two lengths as shown in Fig. 1, the shorter of which is used for holding the replacer against a standard rail. The method of holding the replacer to the rail with the clamp is shown in the drawing in the lower right hand corner of Fig. 1. The extension clamp is designed to be used for derailments at frogs and switches where it is impossible to fasten the hook of the shorter clamp on the flange of the outside rail. The extension is provided with a number of notches on which the extension clamp slide can be adjusted. The replacer is held securely to the rail by the replace clamp wedge which is inserted in the 3⅜-in. by 7/16-in. slot in the clamp. The replacer equipment is carried on the side of the tender.

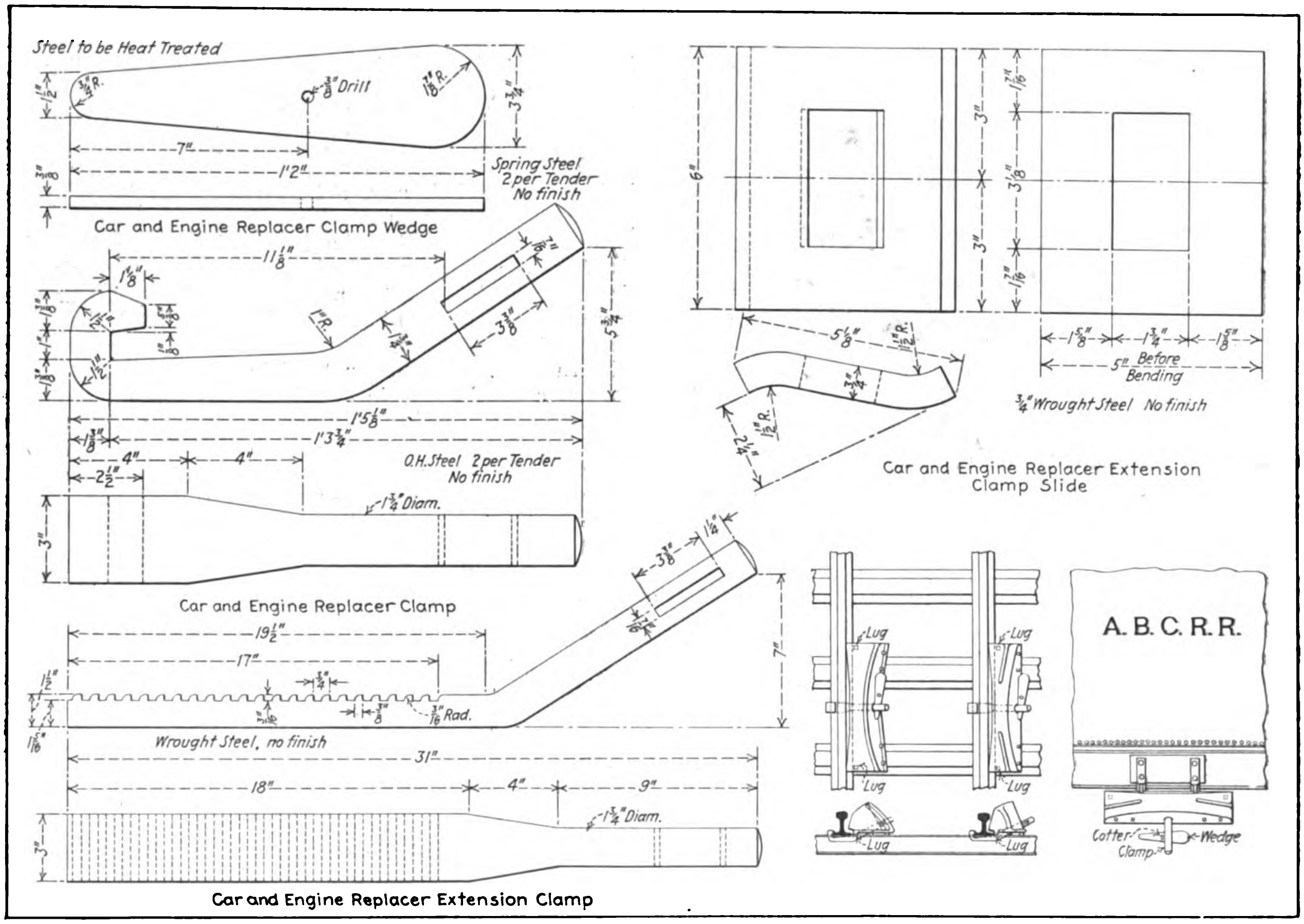
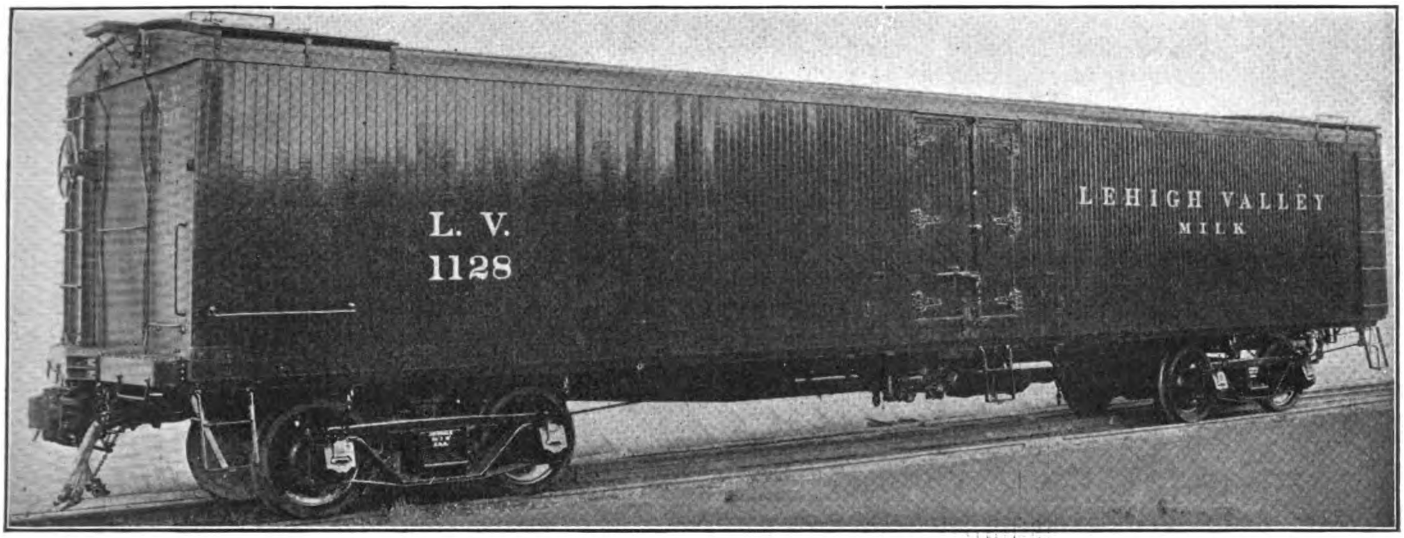


Fig. 1—Drawing of the details of the replacer clamp and the application to the rail



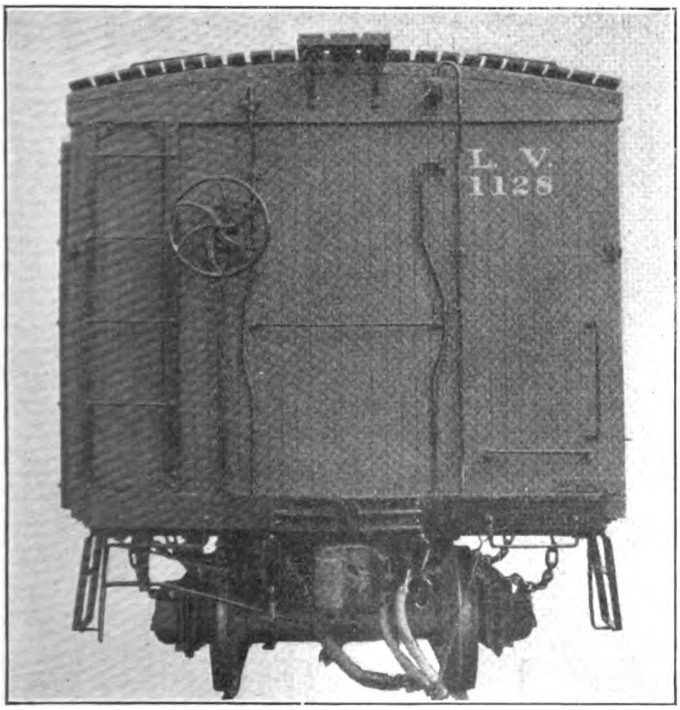
Large capacity milk cars recently built for the Lehigh Valley

New type milk cars for the Lehigh Valley

Departure from conventional design has effected increase in loading capacity—Unique truck construction

THE Lehigh Valley has recently placed in service 25 milk cars, the design of which differs materially from previous equipment used in that class of traffic. These cars were built at the Berwick plant of the American Car & Foundry Company in the early part of 1924.

The change in design has particularly affected the arrangement of the ice bunkers. In previous milk cars the bunkers, four in number, were located at each side of the end door vestibules and extended from floor to roof. In the new cars the end doors have been eliminated and an ice bunker built across each end of the car. The bottom of the bunkers is at a height of 27½ in. from the floor which permits the loading of milk cans underneath. The car body as a whole has been designed with the idea of providing maximum loading capacity and, aside from the change in ice bunker arrangement, the inside width has been increased 6 in. so that eight milk cans may be placed in a row across the car. The side doors have been arranged to swing outward instead of into the car which allows for additional loading space. These changes have served to increase the individual car capacity to a total of 370 40-quart cans which represents an increase of 40 cans over the capacity of previous cars. The ice capacity has been increased from 5,880 lb. to 9,000 lb.



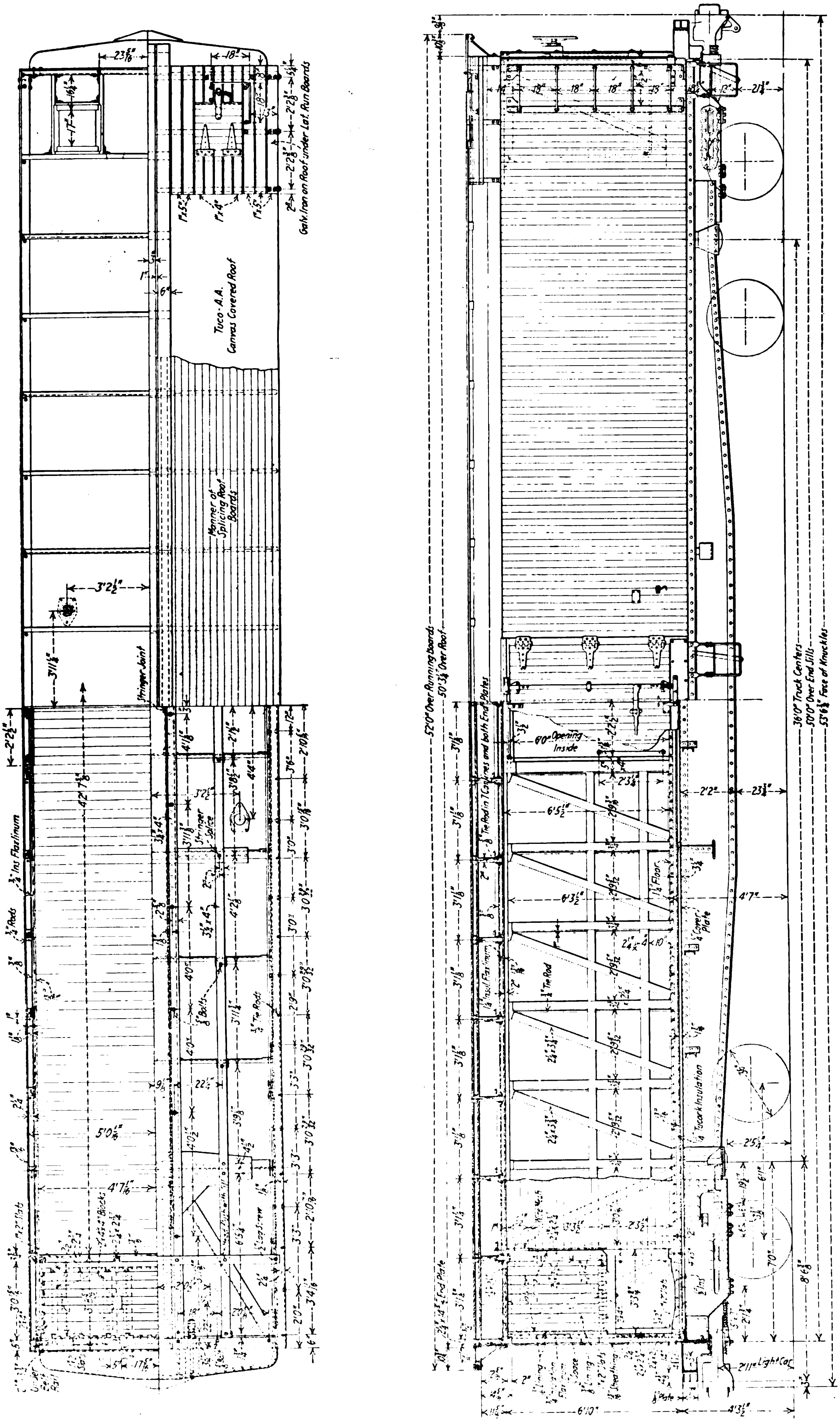
End view of car showing location of retainer, train signal and conductor's brake valves

Principal dimensions and weights

Length over body end sills	50 ft. 0 in.
Length inside	49 ft. 4⅛ in.
Length between bunkers	42 ft. 7⅜ in.
Width inside	9 ft. 2⅛ in.
Width at eaves	10 ft. 1⅞ in.
Total capacity of ice bunkers	9,000 lb.
Distance from center to center of trucks	36 ft. 0 in.
Truck wheel base	6 ft. 1 in.
Net capacity of car, including ice	85,500 lb.
Light weight of car complete	68,400 lb.
Loaded weight of car	153,900 lb.

Underframe construction

These cars have a steel underframe and wooden superstructure. The underframe is of the fish-belly type with double center sills, the depth of these sills at the middle of the car being 26 in. The center sills are of plate and angle girder construction with 5/16-in. web plates reinforced by 3½-in. by 3½-in. by ⅜-in. angles on the outsides of the top chord and by the same size angles on the



Side sectional elevation and plan view of Lehigh Valley milk car

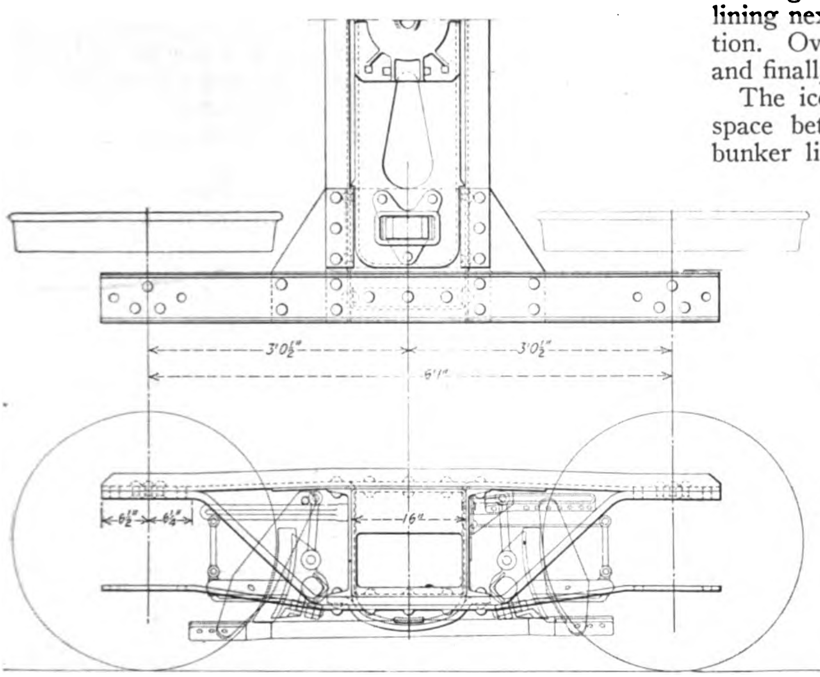
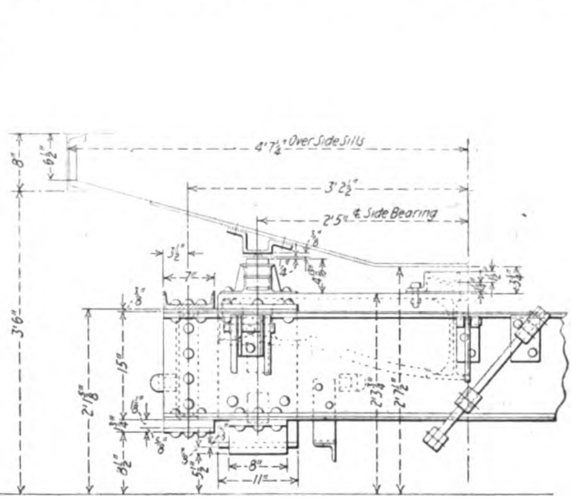
inside and outside of the bottom chords. A 21¼-in. by ¼-in. top cover plate extending the full length of the underframe serves further to reinforce the center sills. The side sills consist of two 8-in., 11.5-lb. channels, to each of which is riveted a 3-in. by 3½-in. by ⅜-in. angle for supporting the wood side sills. The cars are equipped with built up extended end sills as shown in one of the illustrations. The body bolsters, cross-bearers and diaphragms are of conventional design. The underframe construction follows closely that adopted as U.S.R.A. standard design for refrigerator cars.

Car body and trucks

The design of the super-structure provides excellent ventilation. The construction of the body framing follows the usual practice with 2¼-in. by 3¾-in. side posts and diagonal braces. Vertical, transverse and longitudinal tie rods are provided.

The floor construction consists of a 13/16-in. false floor laid over floor stringers, then a 1¼-in. layer of Tucork insulation over which is laid 1¾-in. tongue and grooved flooring. The sides of the car have a 13/16-in. inside lining next to which is a ¾-in. layer of Flaxlinum insulation. Over this is a ⅜-in. lining, then a 2¼-in. air space and finally the outside sheathing, which is 13/16-in. thick.

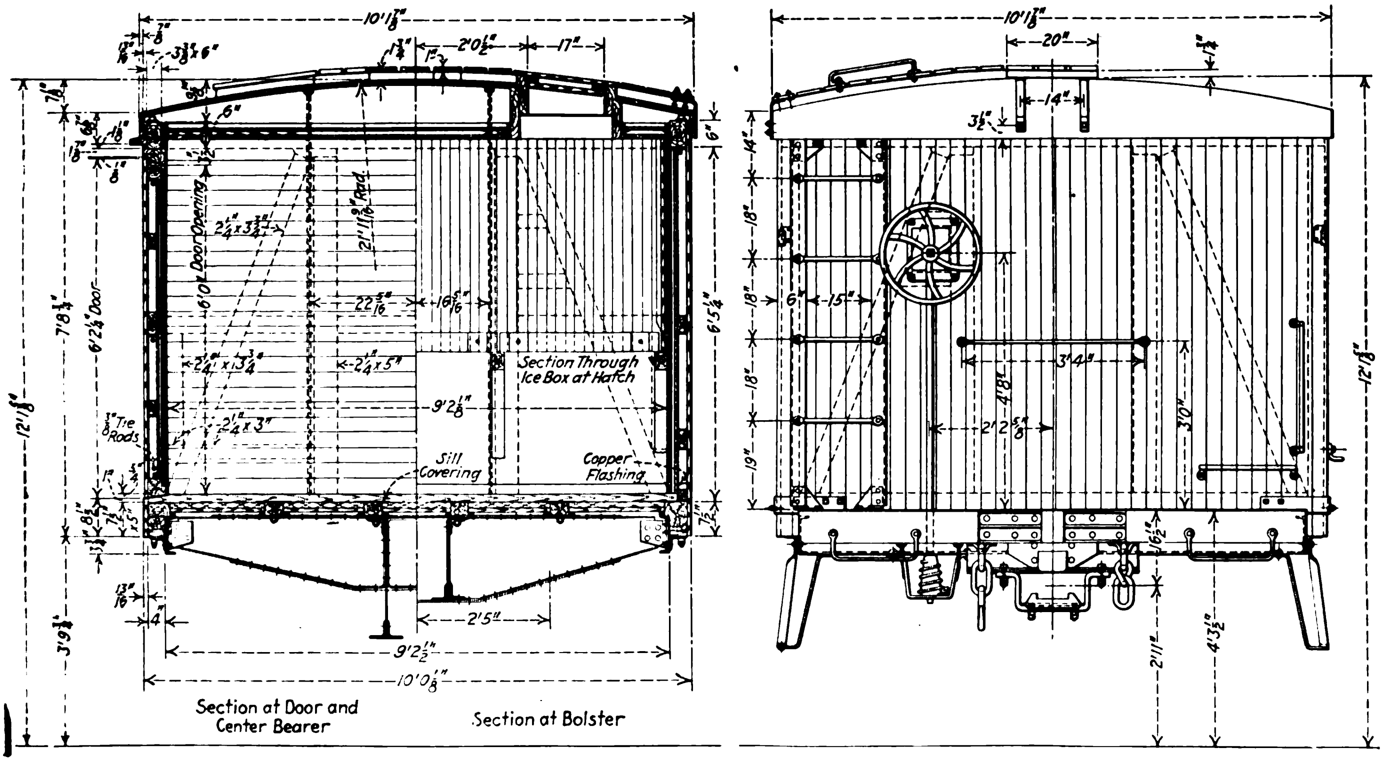
The ice bunkers are further insulated by a ½-in. air space between the inside body lining and a 13/16-in. bunker lining. The inside of the bunkers is lined with galvanized iron over which is secured 1-in. by 2-in. slats. Two icing hatches, with 17-in. openings, have been provided for each bunker.

The truck frame is built up principally of standard structural shapes

The end doors have been eliminated in this design and double side doors, swinging outward, provide an inside opening of 4 ft. 5 in. by 6 ft. A Miner door locking device is used on these doors.

The ceiling, which consists of ⅜-in. and 13/16-in.

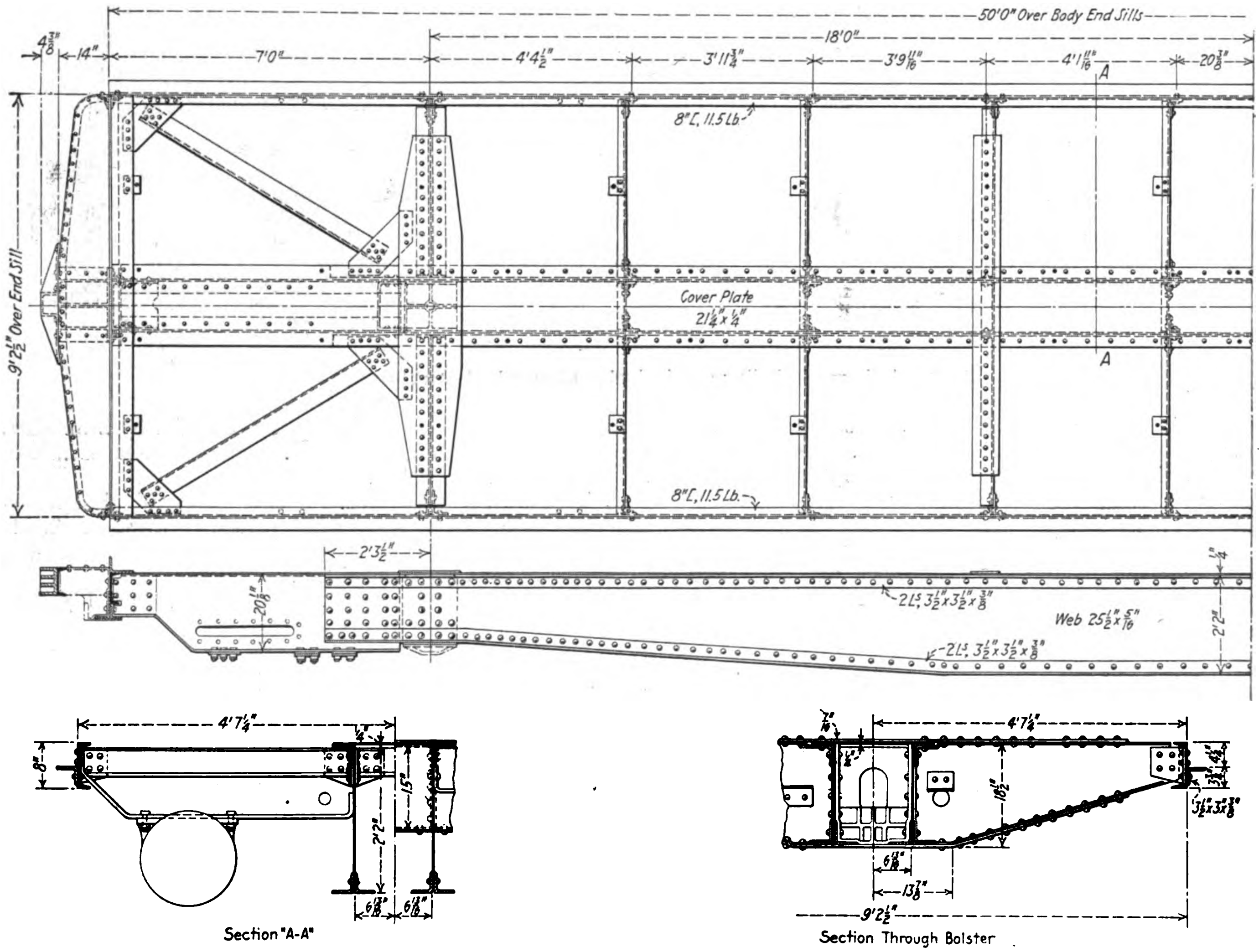


End elevation and cross sections

wood courses with a 1¼-in. layer of Flaxlinum between, is beneath the carlines. The roof sheathing is covered with Tuco A-A canvas. The roof on these cars has been considerably flattened as compared with the conventional oval type roof ordinarily found on milk cars. Running boards of the box car type have been provided the full length of the car.

The cars are carried on trucks with 5½-in. by 10-in. journals and 36-in. wheels. These trucks are unique because of their simple construction. They are of the modified arch bar type, in which the top arch bar consists of a 7-in. channel to which the ends of the 1⅛-in. bottom arch bar is riveted. The column castings and spring plank are replaced by transoms consisting of 15-in. channels, spaced 16 in. apart, which are rigidly secured to the arch bars and reinforced by pressed steel end plates, through which are cut the window openings to accommodate the ends of the full elliptic springs. These springs rest in malleable iron seats supported by yokes of ⅝-in. by 11-in. steel plate, which are flanged over and riveted to the tops of the transom channels. These plates, which also form wearing strips for the ends of the bolster, are reinforced below the spring seats by ⅞-in. by 8-in. plates riveted to the bottom channel flanges.

Westinghouse UC brake equipment and train signal equipment, Bradford draft gear and solid shank couplers with a Chaffee centering device comprise part of the car equipment.



Details of construction of the underframe and body bolsters

Hooks, cables and chains for wrecking service

It is the usual practice to include in wrecking equipment various kinds of hooks and arrangements of chains and cables in order to save time and labor when clearing up wrecks. A few examples of this type of equipment are shown in the drawing. These devices are not only convenient to have in the tool car of the wreck train, but they are also handy to have as part of the crane equipment in locomotive erecting shops and shops where car repairs are handled.

The arrangement of two hooks and chains shown in the upper left hand corner of the drawing is designed primarily for lifting trucks and various kinds of equipment on which it is better to take an inside hold. The chain is ¾-in., hand forged and is designed to carry a safe load of 10,000 lb. These chains are proof tested with a load of 11,160 lb. and have an approximate breaking load of 33,800 lb.

The arrangement of the two hooks and cables shown in the top center of the drawing is made of 1¼-in. bright monitor plow steel cable of six strands, 37 wires to the strand, with a hemp core. The end link and hooks are designed for the same factor of safety as the cable. This device is convenient for such work as lifting cabs and similar parts which are light but bulky to handle. The

working load of each cable used straight is 16,500 lb.

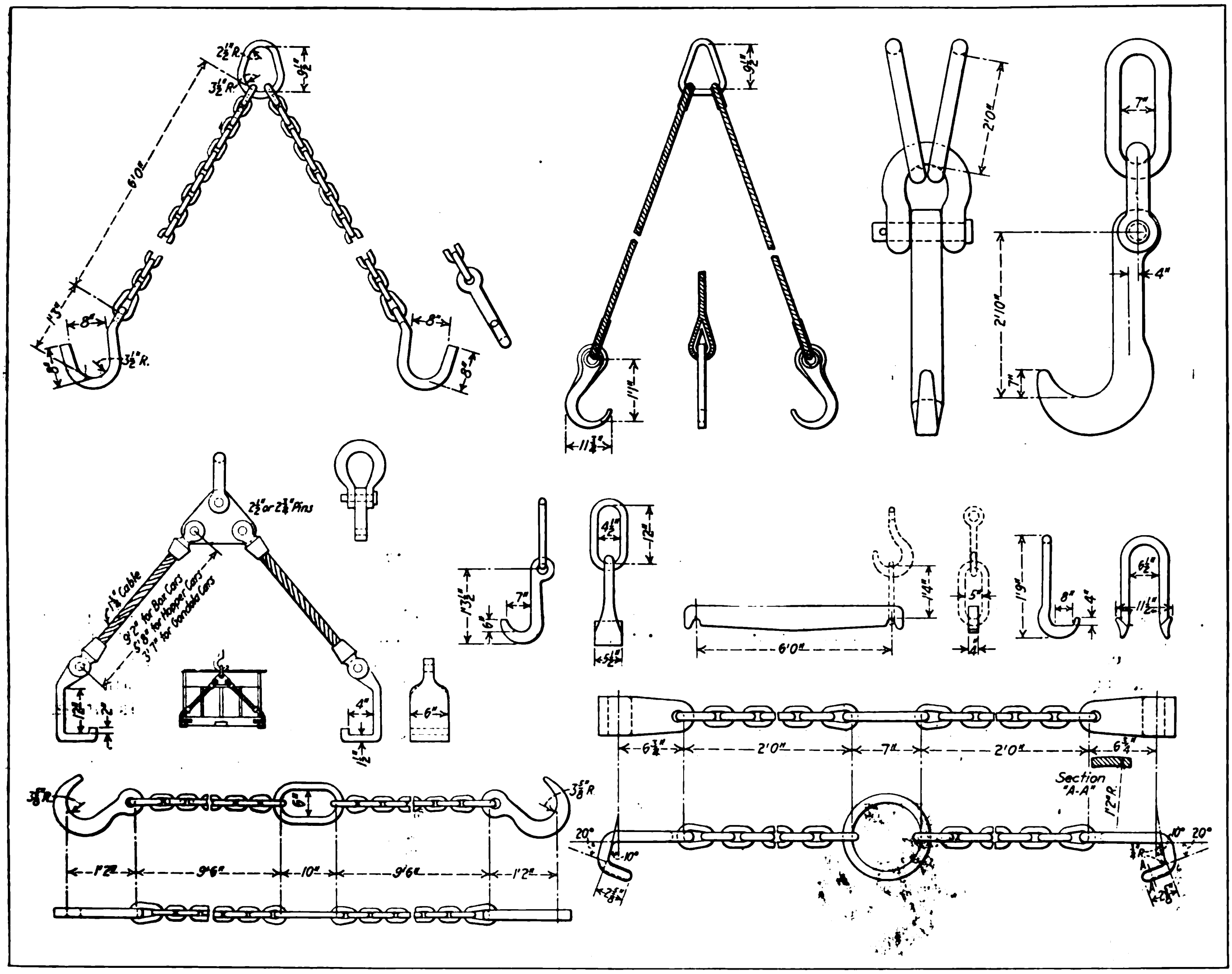
The crane hook shown in the upper right hand corner of the drawing is a fire box door hook. It is designed for heavy lifting, the hook, chains, pin and links having a working load of 100 tons with a factor of safety of five. The design of the hook gives it an exceptionally wide grip and at the same time permits it to hold a chain or cable without danger of slipping off.

The cable and hook arrangement shown at the left center of the drawing is designed especially for handling car bodies. It cannot be used for cars having concealed end sills. The method of application is shown in the small drawing. The design of the hook may be varied to suit the different classes of cars which have to be lifted with a crane.

The arrangement of chains, link and hooks shown in the lower left hand corner of the drawing is intended for general wrecking and crane service. It is designed for a safe load of 16,000 lb. and is proof tested with a load of 20,460 lb. The approximate breaking load is 62,000 lb.

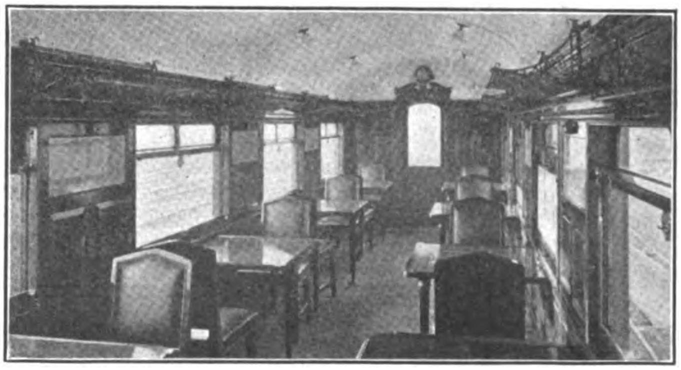
The chains, link and hook shown in the lower right hand corner are made of ¾-in. hand forged iron and are designed for a safe load of 10,000 lb. They are proof tested for 11,160 lb. and have an approximate breaking load of 33,800 lb. The enlarged link and hooks should have as high a factor of safety on the chain.

The double hook shown at the right center of the drawing can be slipped into difficult places and a chain or cable hook slipped through the loop. It is of sufficient strength to carry a load of 25 tons with a factor of safety of five. This hook is proof tested with an actual working load of 125,000 lb.

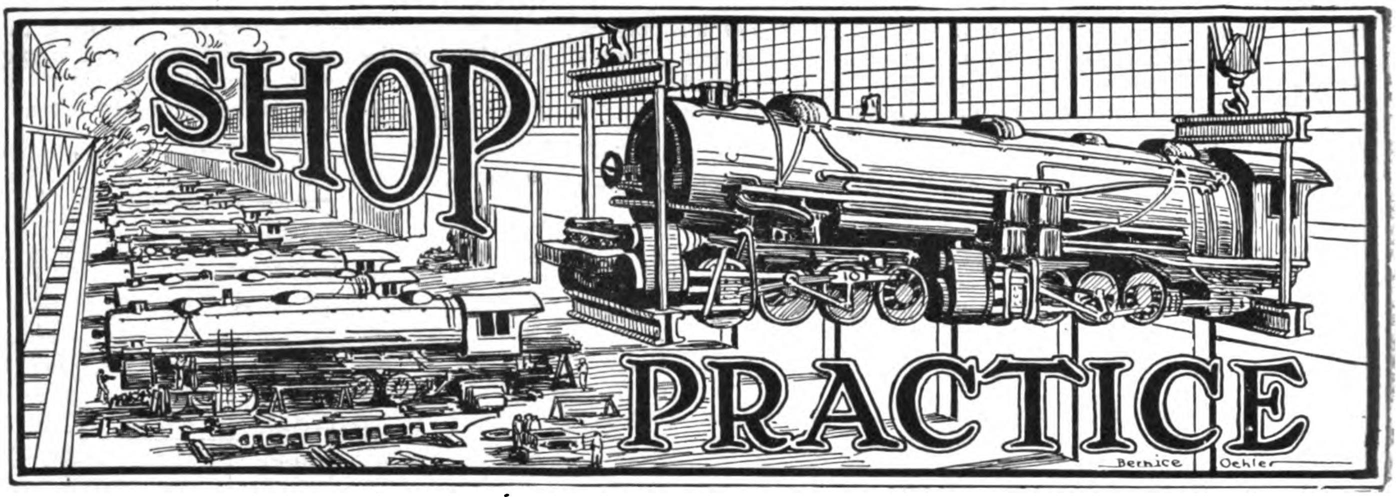


Details of a number of hook, chain and cable arrangements which have proved useful in crane and wrecking service

The hoisting hook and link shown at the left of the lifting beam is also designed for a working load of 25 tons with a factor of safety of five.



Interior of dining car used on the Siamese State Railways

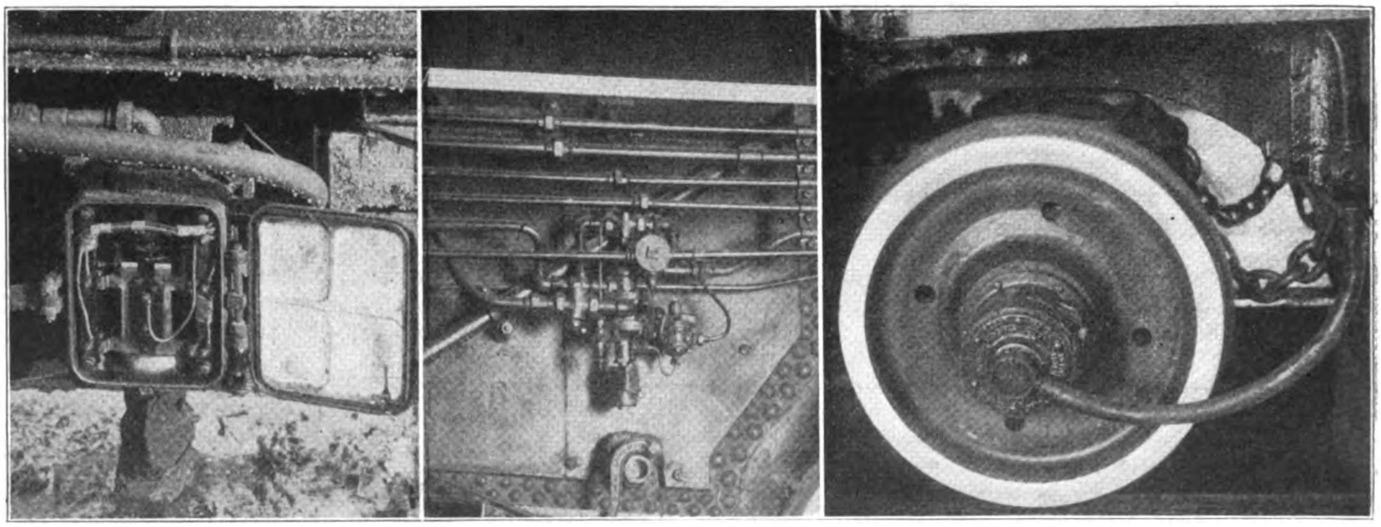


Maintaining train control equipment on locomotives

By E. Wanamaker

Electrical engineer, Chicago, Rock Island & Pacific, Chicago

THE equipment or devices necessary to an automatic train control system include roadside equipment which properly lies within the province of the signal department, and locomotive equipment which comes under the jurisdiction of the mechanical department. The chief mechanical officer is in a position to combine and utilize the skill of the electrical engineer, the mechanical engineer, the air brake engineer, and all others familiar with locomotive operation and maintenance. Familiarity with the many peculiarities of locomotive equipment and devices is a prime requisite.



Open shoe box, electro-pneumatic valve and speed controller—parts which must be maintained

Train control supervisor should be appointed

In order to co-ordinate successfully the efforts of all these in the mechanical department, it is highly advisable, if indeed not absolutely necessary, to appoint a supervisor of automatic train control. This man should preferably be one who has had considerable experience in locomotive mechanical, electrical, and air brake work, as well as some experience in engine service. He will then be better qualified not only to co-ordinate the efforts of those in the mechanical department, but to secure the co-operation of those in the signal department and at the same time enlist the necessary support of the division transportation officers. The successful operation of automatic train control depends quite largely on the skill and fidelity of the division officers functioning under the supervision of the automatic train control supervisor insofar as automatic train control is concerned.

The following paragraphs refer to automatic train control as applied to 165 miles of double track between Blue Island and Rock Island, Ill., on the Chicago, Rock

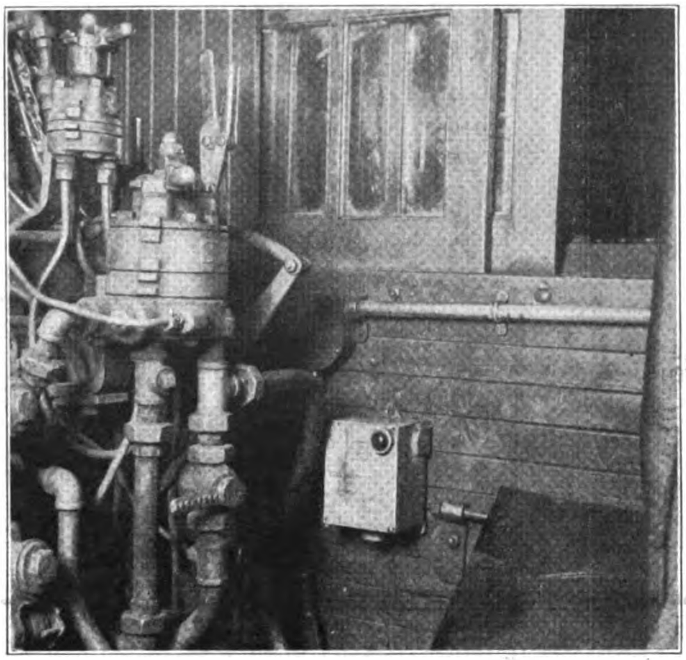
Island & Pacific. The system as now installed is of the intermittent electrical contact type, with 240 ramps installed and 103 locomotives equipped.

Automatic train control operation

Last February the operating rule requiring a train to stop at an automatic stop signal indicating stop, after which it may proceed through the stop block at a speed not to exceed eight miles an hour, was changed so that on all locomotives equipped with the automatic train control in operation the engineman may, upon reducing his speed to below 15 miles an hour, pass the stop signal without stopping and proceed, thus eliminating the stop at the stop signal.

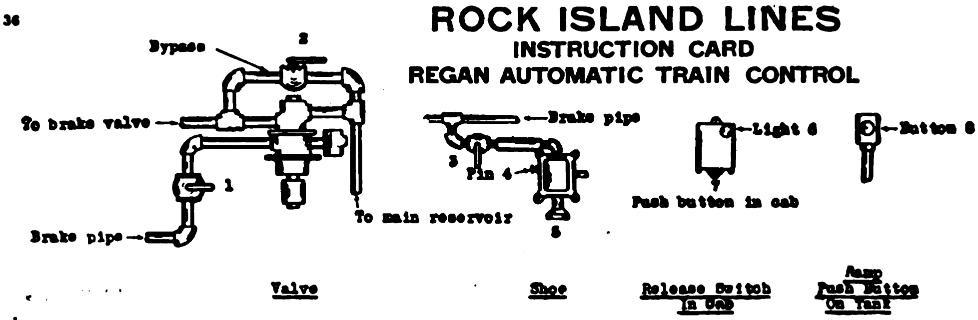
As long as the signals are all clear there is no action of the automatic train control device. If approaching and passing a caution signal above a certain prescribed speed (in the case of a passenger train this speed is 30 miles an hour and for a freight train 25 miles an hour) an automatic brake application will result. This will reduce the speed of the train to within the prescribed limit, and upon arriving at that speed an indicator light is shown in the cab, which is the engineer's indication that he may release the brakes. Upon so doing he can proceed but only at the prescribed limit or speeds below. If he should not be alert for some reason or other and fails to operate the release, then the train will be stopped. Upon continuing through the caution block, if he should happen to exceed the caution limit, another application will result, necessitating a second operation of the release.

Upon approaching the stop signal, and if he should pass it above the prescribed speed, which is 15 miles an hour for both passenger and freight service, an automatic application of the brakes will result and the same releasing operation must be carried out as explained for the caution signal. However, if he should pass this stop signal below 15 miles an hour (having operated a secondary push button which is on the tank and inside the gangway) he can pass over the ramp without an application. If that button is not pushed while he is running below the prescribed speed of 15 miles an hour he will get an application, no matter at what speed he is running,



Cab indicator and release button

whether it be one, five or ten miles an hour. After he has passed the stop signal, if he should exceed the speed of 15 miles an hour or reach that speed at any time, he will get an application which will necessitate a release. If the next signal is clear, his high speed is restored and he can proceed at unlimited speed.



FORM M. P. 36

ROCK ISLAND LINES
INSTRUCTION CARD
REGAN AUTOMATIC TRAIN CONTROL

1. TO CUT DEVICE OUT OF SERVICE: Close cock 1 so that handle is in line with pipe and open cock 2 on bypass so that handle is crosswise with pipe. In case of heavy leak of air at shoe box also close cock 3 so that handle is in line with pipe.

2. TO PLACE DEVICE IN SERVICE: Open cocks 1 and 3 so that handle is crosswise with pipe and close cock 2 on bypass so that handle is in line with pipe.

3. DOUBLE HEADING: When double heading, on rear engine Raise shoe stem 5 to full height; pull out locking pin 4, give it one-quarter turn and see that it has entered the slot full length.

4. OPERATION:

(a) The train control apparatus does not interfere with the proper observance of rules governing air brake operation.

(b) CAUTION SIGNAL will enforce speed throughout the block not to exceed 30 miles per hour for passenger trains and 25 miles per hour for freight trains. To avoid unnecessary application of the brakes, speeds should be maintained below these limits.

(c) STOP SIGNAL: At a stop block, ramp push button number 8 on tank must be pushed in before shoe engages ramp, and held in so long as shoe is on ramp. If stopped with shoe on ramp, button 8 must be pushed in and held in until shoe is off ramp.

(d) A stop signal will enforce speed not to exceed 15 miles per hour throughout the block for both passenger and freight trains. To avoid unnecessary application of the brakes, a speed should be maintained below that limit.

(e) RELEASE SWITCH IN CAB: Whenever devico makes brake pipe reduction, place brake valve in lap position until train is running below prescribed speed; then when indicator light 6 is displayed, push the button 7 which will extinguish the light, and proceed to fellow prescribed rules of proper air brake operation as though you had made the application yourself.

(f) IN CASE OF IMPROPER OPERATION: Should the device improperly apply the brakes, it must not be cut out of service until the ramp next ahead has been passed. The only exception to this rule will be permitted when, with the train at stop, it is impossible to release the brakes after pushing button 7.

(g) Report any improper working of the device to the Train Dispatcher and on work report.

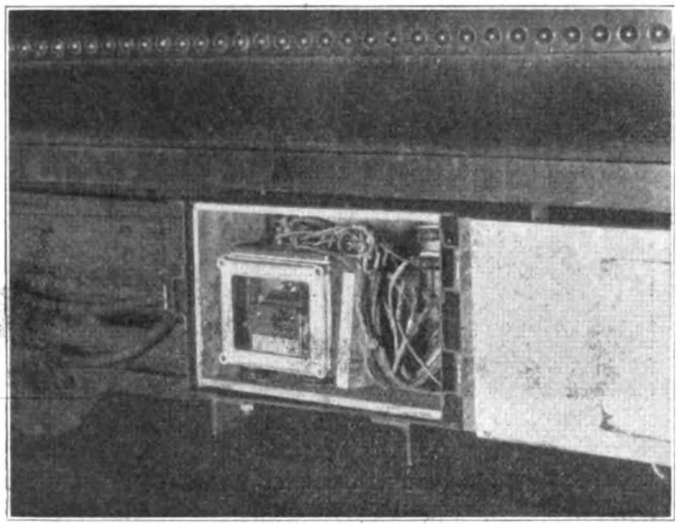
Card placed in the cab for the instruction of enginemen regarding train control operation

The roadside apparatus used is a ramp located at each signal, the energy supply to the ramp being from a roadside battery controlled by the signal circuits. The loco-

motive apparatus consists of the shoe mechanism located on the No. 1 tank truck; an indication selector or relay and storage battery; the speed controller on the No. 1 engine truck wheel; an electro-pneumatic reservoir and brake valve, with an exhaust control valve and suitable cocks arranged so as to cut the apparatus out in case it should be necessary; release switch; and tank button, all suitably connected by conduit and wire.

The electrical engineer has general supervision

The automatic train control is supervised by the electrical engineer who acts more or less as the directing and consulting engineer in connection therewith. The supervisor of automatic train control, reporting directly to the superintendent of motive power of the first district, also works in direct contact with the superintendent's office. A clerk is employed in the superintendent's office to follow in detail the operation of each locomotive, compile information and data, and quickly transmit to the supervisor of automatic train control any irregularity of operation that shows up, for his immediate attention. This clerk is one of the most important links in train control operation. He should be a man of considerable ability. He is charged with the responsibility of interpreting the reports from the various maintenance points and train dispatcher and following them up for corrective action when necessary.



Relay box—One reason why maintainers must understand electrical circuits

Automatic train control locomotive maintainers are located at the various locomotive terminals on the division, of which there are five maintenance points, two at Chicago, one at Peoria, Ill., and two at Rock Island, Ill., the western terminus of the division. In general the regular electrical maintenance men at enginehouses and back shops absorb most of the work so that comparatively few maintainers are needed and the working hours of these men are arranged to meet the requirements of the engines dispatched. In other words it is not always necessary to have a maintainer and helper on each shift at each of the maintenance points. The work of these men is arranged so as to utilize fully the available man power.

The maintainers report to the roundhouse foremen, who are responsible for the locomotives getting out on time and in satisfactory condition, both as to mechanical features and electrical features. Therefore, it is highly important, if not the most important duty of the supervisor of automatic train control, to see that good relations exist between the maintenance forces and the roundhouse authorities, and to act in accord with the roundhouse forces; to make of himself a good influence on the division, looked up to and respected by every operating officer concerned in both the transportation and mechanical departments as well as soliciting the unqualified support of the enginemen. The degree of success he makes in this direction is an important factor in the smoothness, quickness and intelligence with which the train control is maintained and operated. He must become well acquainted with the enginemen, firemen, trainmen and conductors; he must so conduct himself that these men will look to him for information and advice and depend upon him implicitly in train control matters.

The train control apparatus is maintained in a similar manner to any other locomotive appliance; that is, the engineman, upon arrival at a terminal fills out in a space provided on his engineman's work report, the condition of the automatic train control apparatus. If some repairs are necessary a work slip is made out from this work report the same as for any other part of the locomotive, and handed to the train control maintainer. The train control maintainer makes such inspection and repairs as are deemed advisable and reports back to the foreman, signing the work report accordingly. At the end of each day, another form called "The Automatic Train Control Inspection Report," is filled out, giving a record of all locomotives arriving at that particular terminal, the condition on arrival, and any remarks considered necessary to explain the condition of the train control equipment. This form also gives a record of all locomotives departing from the terminal and the condition in which they were dispatched. It is mailed to the superintendent's office for the files of the automatic train control clerk, one copy being retained in the roundhouse foreman's office. In

ROCK ISLAND LINES

SEMI-ANNUAL INSPECTION REPORT AUTOMATIC TRAIN CONTROL
LOCOMOTIVE APPARATUS

INDICATION SELECTOR														Stick Release Switch		Electro-Magnet			
Motor								Clutch Release		Mechanical Lock									
Drop-Away				Pick-Up															
High Speed		Med. Speed		High Speed		Med. Speed		High Speed	Med. Speed	Pick-up		Drop-away		Release		Pick-up		Drop-away	
Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Amps.	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.:

Semi-annual inspection report forwarded to the electrical engineer's office

this way a complete and accurate record of the operation of the automatic train control is compiled.

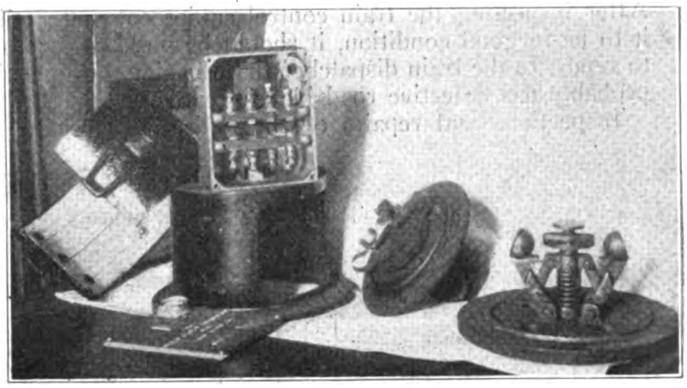
In addition, a report form called "The Record Card" is carried on each locomotive. Any repairs made are noted on this report form each time a locomotive enters a locomotive terminal and at the end of the month the card is removed and mailed to the electrical engineer's office in order that he may have a complete history of the operation of each locomotive at all times.

Thorough knowledge of air brakes essential

To understand, operate and maintain automatic train control intelligently it is imperative that the electrical engineer, train control supervisor, and maintenance forces be thoroughly familiar with the theory of application, maintenance and operation of the air brake systems, not only on the locomotive but upon all rolling stock. They must have an intimate knowledge of locomotive operation and maintenance. They should also have sufficient knowledge of the operation of the signal system upon which the train control has been superimposed to have an understanding as to the control of the roadside element by the signal.

The reservoir and exhaust control valve, which is the air appliance of the automatic train control equipment, is inserted in the air brake lines of the locomotive, and unless the maintainer has sound knowledge of the air brake system, it is easy for him to become confused, resulting in confusion of installation and operation of the air brake equipment of the locomotive as well as of the automatic train control system. For instance, a defective feed valve has caused violent fluctuations of the train line air gage on the locomotive, resulting in the cutting out of the automatic train control by the engineman, and it becomes necessary for the train control forces to be able to detect and explain satisfactorily to the engineman what his trouble actually was. The train control organization must also know the effect of air brake applications upon moving trains, particularly freight trains, and the effects of various reductions and rates of reduction upon the slack action of the trains, as they will be called upon from time to time to discuss these things with enginemen in order to bring about a more complete understanding of train control and its operation.

They must understand locomotive conditions as they develop in operation in order to handle the train control equipment properly. For instance, locomotive tender truck wheels develop flat spots occasionally and begin to pound so severely that the train control attachments become disturbed. They loosen up and the supervisor or maintenance men must pick out these cases for correction by the roundhouse forces. They must be acquainted with all of the government requirements as to clearances, arrangement, etc., that are wrapped about the maintenance of locomotives, so that the train control will not interfere in any way with these requirements. They must work hand in hand with the air brake repairmen and engine inspectors in order that complete co-ordination with air work may result. Their operations must be so conducted as to create a feeling of good fellowship among all concerned.



Parts of speed controller and open view of release box

Form MP 116

Record Card
Automatic Train Control

Battery Applied No._____ Date_____

Speed Circuit Controller Set and Tested: Medium_____ Date_____ ; Low_____ Date_____

Engine No._____

Month_____

Date Tested: Magnet_____ ; I. S. Relay_____ ; Release Switch_____

Speed Circuit Controller Greased (Date)_____ R. & B. Valve Cleaned and Tested (Date)_____

Date	Brake Appl. Lbs.	Shoe Gauge	Gravity	A. T. C. Working on Arrival	REPORT HERE ANY WORK DONE	Place	Maintainer's Name
1							
2							
3							
29							
30							
31							

Note #1 When changing cards transfer Speed Circuit Controller greasing, setting and testing dates, battery number and application date, R. & B. Valve cleaning and test date, Magnet, I. S. Relay and Release Switch testing date to new card.

Note #2 Speed Circuit Controller must be greased every 60 days, R. & B. Valve cleaned every 6 months, I. S. Relay & Release Switch tested every 12 months, and Magnet tested every 6 months.

Note #3 Forward card from first terminal reached on last day of month to Electrical Engineer, Chicago, Ill. inserting new card as instructed in Note No. 1.

Note #4 Note on back of card any defects or trouble encountered.

Train control record card 8½ in. by 11 in. in size which is carried on each locomotive

Maintainers need working knowledge of signals

The mechanical department automatic train control maintainers should have a working knowledge of that

part of the signal system that controls the roadside elements; that is, they should have a general understanding as to how the different indications are transmitted to the ramp in accordance with the signal indication. This is necessary in order that they can interpret such operations as reported applications of the brakes at a clear signal, etc., particularly where it is the only signal encountered on the trip, at which such an application was received. After inspecting the train control equipment and finding it to be in good condition, it should be possible for them to report to the train dispatcher that the signal in question probably has defective roadside apparatus.

Inspections and repairs of the indication selector, release switch and magnet are reported on one of the forms illustrated, being filled out semi-annually and forwarded to the electrical engineer's office.

The general instructions for automatic train control operation and maintenance are contained in a 38-page pocket size book of rules and instructions issued to all concerned. Electrical engineer's circulars are issued from time to time as necessary, giving detail instructions for the maintenance of the automatic train control equipment. Some important detail instructions for enginemen are contained in an instruction card, illustrated. One of these cards for ready reference is placed in the cab of each locomotive equipped with automatic train control.

Train control assists mechanical and operating men

The results of the operation of train control are particularly interesting and important to the mechanical department. It is permissible for trains hauled by locomotives equipped with automatic train control in operating condition to pass an automatic stop signal indicating "Stop" without bringing the train to a full stop, as a reduction to below the low prescribed speed limit of 15 miles an hour, and the continuous control of this speed through the red block, has obviated such a necessity. All mechanical men, traveling engineers, road foremen of equipment, etc., fully realize the importance of not bringing a train to a stop except when absolutely necessary. The elimination of unnecessary stops results in economy of fuel, reduces the number of drawbars pulled out and lessens wear and tear on equipment, such as draft gear, drawbars, knuckle pins, brake riggings, etc., all of which helps to reduce operating and maintenance costs.

The automatic train control clerk in the division superintendent's office is constantly in close touch with the entire train control situation through the chief dispatcher, also directly by telephone or telegraph with the shop and roundhouse foremen, and in daily contact with the trainmaster. This close contact, together with the regular form reports, including emergency or trouble wire reports, enables the automatic train control clerk to keep a close check on each individual locomotive and signal equipped with automatic train control, handling any trouble for immediate correction. At the end of the month he makes an analysis sheet from his daily records kept for each locomotive, etc., and from this analysis sheet forms his monthly report for the chief operating officer and the Interstate Commerce Commission.

R. I. **ROCK ISLAND LINES** Form M. P. 114

DAILY INSPECTION REPORT AUTOMATIC TRAIN CONTROL

LOCOMOTIVE EQUIPMENT

Time 12:01 a. m. to 12:00 p. m. Place________ Date________

Eng.	Train In		Train Out	Battery	Ind Selector	Shoe Box	Stop Ramp Buttons	Release Switch	R & B Valve	Speed Controller	Wiring	Conduit	Piping	Condition When Disp.	Cond. Form M. P. 36	REMARKS
	No.	Interruption														

Total Engines Dispatched________

Roundhouse Foreman must not O. K. a Train Control Equipped Road Engine for service unless Train Control is in operating condition.

SIGNED: R. H. Foreman________

R. H. Foreman________

Maintainer________

Maintainer________

Inspection report filled out daily by enginemen on arrival of locomotives at terminal points

These monthly reports on the Rock Island show a steady improvement in both operation and maintenance as our knowledge of the equipment increases.

Jig for planing the boiler radius on cylinder saddles

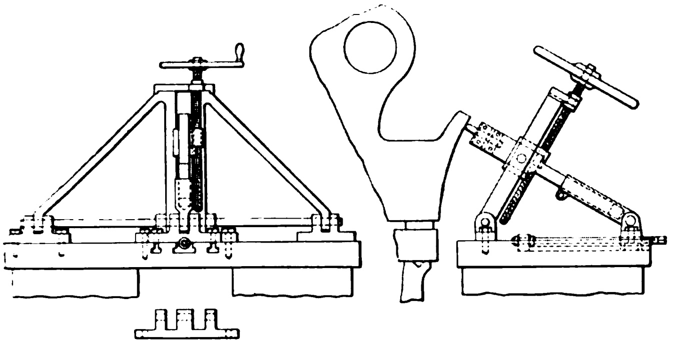
By C. G. Williams

ONE of the numerous problems of railroad shop work is the replacement of cylinders in cases where the originals have been worn out, broken or where replacement has become necessary in order to eliminate the old slide valves. The main item is the cost of finishing the saddles to fit the radius of the boiler. This operation has been performed in various ways, from chipping with a hammer and chisel or by using an air hammer, to planing slots to the layout lines on a planer and then chipping out the bridges with a hand chisel and sledge. The finishing has then been done with an air hammer or by attempting to follow the radius with a planer tool. This is a tedious and inaccurate job and costs money.

The Hoisington, Kans., shops of the Missouri Pacific has devised a practical and quick method for doing this work by the use of the fixture shown in the sketch. This fixture is placed on a heavy face plate, 8 ft. by 3 ft. 6 in., and 8 in. thick. It is placed on two concrete pillars set parallel with the bed of the planer which is used to plane up the backs of the cylinders and the plate is located about two inches lower than the top of the planer bed. This permits the center of the pin to go through the end of the radius bar about two inches higher than the bed of the planer and also allows the machinist to use two-inch parallels under the back of the

cylinder. The radius bar is then set to the radius of the smokebox and the saddle is planed to fit.

No provision was made in the original fixture to allow for lengthening the radius bar to suit the various radii, other than the slight amount that the yoke might be raised, or the cylinder set back from the edge of the planer bed, because the fulcrum was fixed. The writer has suggested an improvement in the drawing which will give a variable fulcrum by sliding the base of the radius bar by the use of a screw.



Sketch showing the construction of a jig for planing the radius on cylinder saddles

This improvement has been recommended by the shop officers to be incorporated in the original fixture so that it can be used for planing cylinders on the largest power now in use on this road. Another improvement is the graduation of the sliding member of the radius bar so that the radius may be determined directly from the bar and not by the use of a tram.

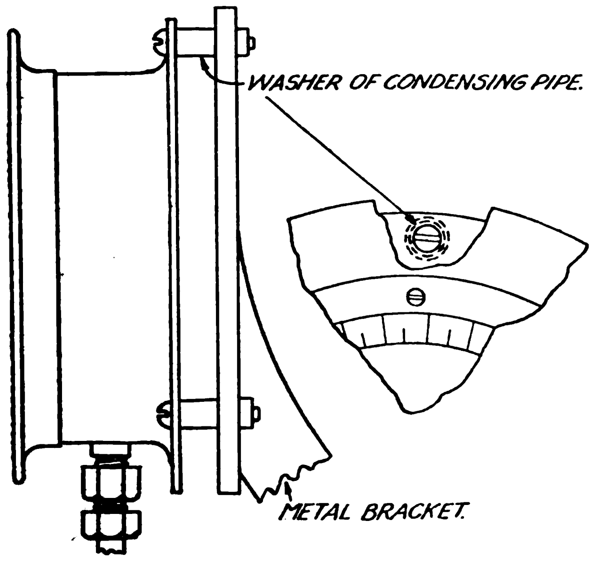
With this fixture it is possible to plane a pair of cylinder saddles to the correct boiler radius in five hours.

Method of applying gages to eliminate vibration

By Frank Bentley

Machinist, Chicago & North Western, Missouri Valley, Iowa

THE two common methods of securing air and steam gages, though expedient for fastening the gages in place, are not very permanent. If wooden washers or clips are used between the gage casing and the metal bracket, they are prone to split, which results in a loose, rattling gage. More particularly is this the case when the location of the gage subjects it to heat and vibration. If it is to be installed on a wall or wooden surface, the usual practice is to make a block near in size to the diameter of the back of the casing. This is, of course, fastened to the wall and the gage to the block, to permit free access to the connecting nipple. If the block is not carefully made an untidy job is the result, in addition to the liability of splitting, as several screws are applied in putting the two pieces in place.

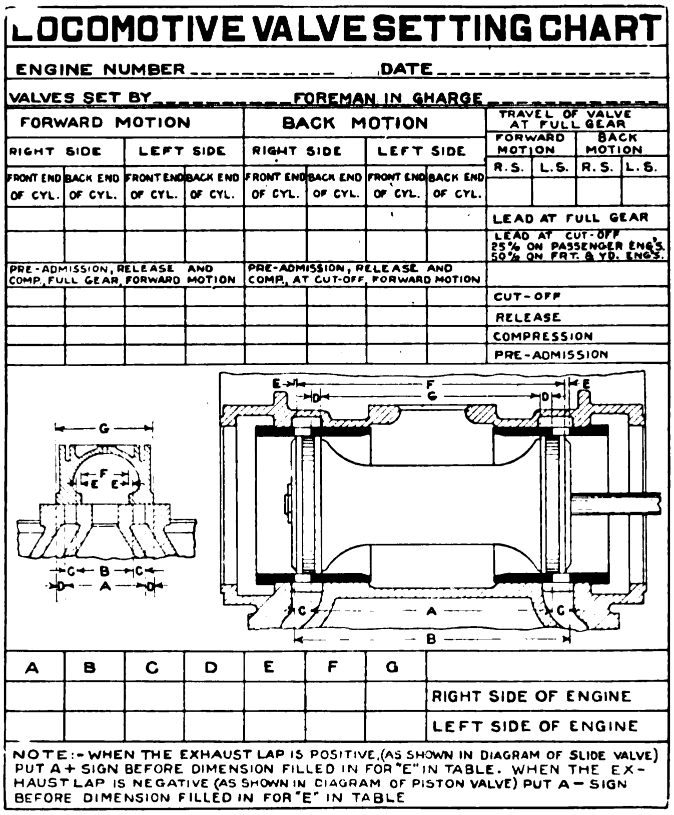


A neat, permanent and easy method of fastening gages

The illustration shows a simple way of fastening gages which is neat, permanent, and easily done. Short pieces of old lubricator condensing pipes are sawed off, squared on a file, and used to block out the gage. It is held against these pieces by the casing screws or bolts. The small pieces of the brass condensing pipe do not protrude over the circumference of the casing or body. They are light and take paint or bronze readily, and will not break or crack under heat or vibration. They can be used to secure the gage to a wooden surface of any kind without splitting it. They can be cut any desired length, and afford a strong back support for a fairly large gage.

Locomotive valve setting chart

A CONVENIENT form for keeping a record of the valve setting on locomotives is shown in the drawing. This form can be drawn on a tracing in the drafting room from which blue print copies may be made. The chart is



LOCOMOTIVE VALVE SETTING CHART

ENGINE NUMBER ____________ DATE ____________

VALVES SET BY ____________ FOREMAN IN CHARGE ____________

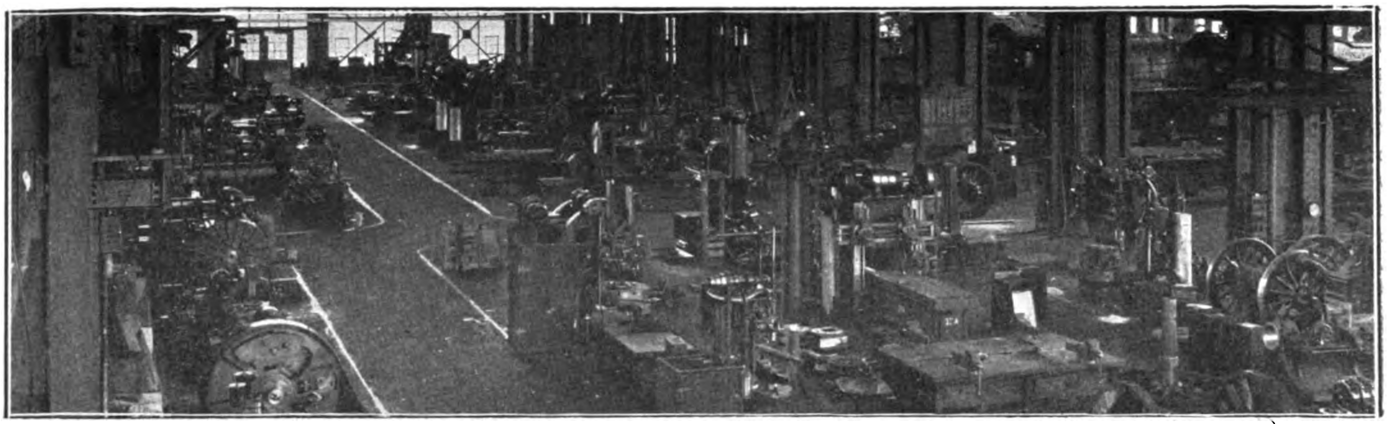
FORWARD MOTION				BACK MOTION				TRAVEL OF VALVE AT FULL GEAR			
RIGHT SIDE		LEFT SIDE		RIGHT SIDE		LEFT SIDE		FORWARD MOTION		BACK MOTION	
FRONT END OF CYL.	BACK END OF CYL.	FRONT END OF CYL.	BACK END OF CYL.	FRONT END OF CYL.	BACK END OF CYL.	FRONT END OF CYL.	BACK END OF CYL.	R. S.	L. S.	R. S.	L. S.
								LEAD AT FULL GEAR			
								LEAD AT CUT-OFF 25% ON PASSENGER ENG'S. 50% ON FRT. & YD. ENG'S.			
PRE-ADMISSION, RELEASE AND COMP., FULL GEAR, FORWARD MOTION				PRE-ADMISSION, RELEASE AND COMP., AT CUT-OFF, FORWARD MOTION							
								CUT-OFF			
								RELEASE			
								COMPRESSION			
								PRE-ADMISSION			

A	B	C	D	E	F	G	
							RIGHT SIDE OF ENGINE
							LEFT SIDE OF ENGINE

NOTE:- WHEN THE EXHAUST LAP IS POSITIVE, (AS SHOWN IN DIAGRAM OF SLIDE VALVE) PUT A + SIGN BEFORE DIMENSION FILLED IN FOR "E" IN TABLE. WHEN THE EXHAUST LAP IS NEGATIVE (AS SHOWN IN DIAGRAM OF PISTON VALVE) PUT A − SIGN BEFORE DIMENSION FILLED IN FOR "E" IN TABLE

A convenient form for keeping a record of the valve setting of locomotives

filled out by the mechanic who sets the valves and duplicate copies for the mechanical engineer and master mechanic are typewritten. This record is valuable in checking cases where locomotives have not been working properly and readjustments of the valve gear are desired. It is also convenient to have such a record available for purposes of comparing locomotives with others of the same class.



The year's purchases of machine tools

Lists from 85 roads indicate a $14,000,000 expenditure; Demand likely to be greater in 1925

By L. R. Gurley

USING as a basis figures submitted by a group of railroads representing over 50 per cent of the track mileage in the United States, Canada and Mexico, it has been estimated that during the past year the railroads of North America spent approximately $14,400,000 for machine tools. Such budget figures as are available indicate that the railroads of the same territory will spend about $17,000,000 for shop machinery in 1925, which will exceed last year's expenditures by $2,600,000. The rapidly rising business barometer indicates that this figure may even be exceeded if the financial situation of the roads proves stronger in 1925 than in 1924.

On page 101 of the January 3 issue of the Railway Age will be found an article on "Machine Tools Purchased During 1924" which contains two tables giving in total numbers the various types of machines purchased by approximately 100 railroads of North America. These figures show that the railroads purchased 337 lathes, 178 drill presses, 127 planers, shapers and slotters, 80 boring mills, 50 milling machines, 240 grinding machines, 96 bolt and pipe cutting and threading machines, 51 portable boring facing and turning machines, 78 power presses, 54 hammers and forging machines, 108 boiler shop machine tools, including punches and shears, 64 flue shop machines and 146 wood working machines. The lists of machine tools here shown give in detail the size and capacity of the individual tools, as well as the name of the builder or dealer from whom they were purchased.

As might be expected, the lathe leads all other types of machine tools in the number purchased. Of the total of 337 lathes purchased, 209 are engine lathes. It is interesting to note that 93 turret lathes were purchased, which seems to indicate a real growth in the extent to which work is being put on a production basis. The indispensable drill press ranks next in importance to the lathe. From the data submitted, it was found that the smaller, belt driven, drill presses are being replaced by powerful, high-speed, motor driven machines. The last 15 years has witnessed an immense increase in the size of locomotives which has led to the adoption of large steel castings, some of alloy steel, and alloy steel forgings. Twist drill manufacturers have developed high-speed drills to handle these materials effectively, and it is being realized that it is false economy to use machines which will not pull these drills.

During the past few years considerable has been written and said about the place the grinding and milling machines would take in the railroad shops. A machine tool expert of one of the largest railroads of the country recently stated that in future years milling and grinding machines will rank in importance next to the lathe and the drill press. The railroads purchased 240 grinders of which 50 were precision machines and the remainder, tool and floor grinders. They also purchased 50 milling machines. These figures indicate a well defined trend in the direction of the above forecast.

The railroads purchased 80 boring mills of which 64 were of the vertical and 16 of the horizontal type. The latter apparently is used to handle a variety of general work while the former is used for production work.

It is evident that the slotter is being replaced by tools of other types. Only 13 are included in the lists. The planer and the shaper, however, hold places of importance in the purchases of the railroads. The lists include 40 planers and 74 shapers.

A total of 78 power presses were purchased during the past year. The presses shown in the accompanying lists are divided between those of high capacity for wheels and comparatively light bushing presses. Again, the increase in the size of locomotives has resulted in increasing the pressures required for forcing off and on wheels, crank pins and bushings which can not be efficiently done on presses that were installed 15 or 20 years ago to handle the smaller class of rolling equipment in use at that time.

The flue and boiler shops were equipped with a considerable number of new machines during 1924. Flue welders, mainly the electric type, received considerable attention as a necessary addition to a modern flue shop. The flanger and forming rolls with a scattering of riveters constituted the bulk of the purchases.

In spite of the tendency to change wooden cars to steel construction, 146 units of woodworking machinery were bought during the past year. Wooden passenger cars are fast disappearing, but it will be many years before all freight cars are built of steel. Consequently, the demand for woodworking machinery will continue.

A few of the large railroads of the country declined to report while others sent in no reports of any kind. Still others reported no purchases during 1924.

A list of the machine tools (metal cutting and forming) purchased by the railways during 1924

Alabama & Vicksburg

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 379-B	Vert. hollow chisel mortising mach.	J. A. Fay & Egan Co.
1	No. 6	Single cylinder surface planer	J. A. Fay & Egan Co.
1	No. 345	Band sawing machine	J. A. Fay & Egan Co.
1	No. 414	Universal woodworker	J. A. Fay & Egan Co.

Atchison, Topeka & Santa Fe

No.	Size and capacity	Type of machine	Builder or dealer
1		Axle journal turning lathe	Niles-Bement-Pond Co.
2		Double end car axle lathes	Niles-Bement-Pond Co.
1	14-in. by 6-ft.	Portable engine lathe	Manning, Maxwell & Moore
3	16-in. by 6-ft.	Portable engine lathes	Manning, Maxwell & Moore
7	16-in. by 6-ft.	Portable engine lathes	Herberts Machinery & Supply Co.
1	16-in. by 8-ft.	Engine lathe	Manning, Maxwell & Moore
1	16-in. by 8-ft.	Engine lathe	Hendey Machine Co.
2	20-in. by 8-ft.	Engine lathes	Manning, Maxwell & Moore
1	20-in. by 12-ft.	Engine lathe	Manning, Maxwell & Moore
2	20-in. by 18-ft.	Engine lathes	Manning, Maxwell & Moore
1	21in. by 16-ft.	Engine lathe	Louis G. Henes
1	23-in. by 10-ft.	Engine lathe	Niles-Bement-Pond Co.
1	23-in. by 12-ft.	Engine lathe	Niles-Bement-Pond Co.
1	24-in. by 12-ft.	Engine lathe	Manning, Maxwell & Moore
1	24-in. by 14-ft.	Engine lathe	Jos. T. Ryerson & Son
1	26-in. by 12-ft.	Engine lathe	Manning, Maxwell & Moore
1	30-in. by 12-ft.	Engine lathe	Niles-Bement-Pond Co.
1	30-in. by 24-ft.	Engine lathe	Harron, Richard & McCone Co.
1	36-in. by 16-ft.	Engine lathe	Manning, Maxwell & Moore
1	42-in. by 14-ft.	Engine lathe	Harron, Richard & McCone Co.
1	48-in. by 16-ft.	Engine lathe	Harron, Richard & McCone Co.
1	2-in. by 24-in.	Turret lathe	Jones & Lamson Machine Co.
1	2¼-in. by 24-in.	Turret lathe	Jones & Lamson Machine Co.
1	2¼-in. by 26-in.	Flat turret lathe	Jones & Lamson Machine Co.
1	12-in. by 6-ft.	Turret lathe	Hendrie & Bolthoff M. & S. Co.
2	16-in. by 6-ft.	Turret lathes	Manning, Maxwell & Moore.
2	18½-in. by 6-ft.	Turret lathes	Warner & Swasey Co.
1	21-in. by 8-ft.	Turret lathe	Waterhouse & Lester Co.
1	25-in. by 10-ft.	Turret lathe	Waterhouse & Lester Co.
1		Turret lathe	Harron, Richard & McCone Co.
1		Universal turret lathe	Hendrie & Bolthoff M. & S. Co.
1		Wheel journal truing machine	Niles-Bement-Pond Co.
1	54-in.	Tire turning lathe	Niles-Bement-Pond Co.
2		Nut facing machines	Herberts Machinery & Supply Co.
1	4-ft.	Radial drill	E. L. Essley Machinery Corp.
1	5-ft.	Radial drill	Smith-Booth-Usher Co.
1	5-ft.	Radial drill	E. L. Essley Machinery Corp.
1	6-ft.	Radial drill	Manning, Maxwell & Moore
1	6-ft.	Radial drill	Smith-Booth-Usher Co.
1	6-ft.	Radial drill	E. L. Essley Machinery Corp.
1	6-ft.	Drilling and tapping machine	Smith-Booth-Usher Co.
1	7-ft.	Radial drill	Smith-Booth-Usher Co.
1		Radial drill and tapper	Marshall & Buschart Mchy. Co.
1	20-in.	Drill press	E. L. Essley Machinery Corp.
5	24-in.	Upright drill presses	E. L. Essley Machinery Corp.
5	24-in.	Motor driven drill presses	E. L. Essley Machinery Corp.
2		Vertical drill presses	Consolidated Mach. Tool Corp.
1		Upright drill press	E. L. Essley Machinery Corp.
1	16-in.	Sensitive floor drill	Crerar, Adams & Co.
1	24-in.	Bench drill	E. L. Essley Machinery Corp.
1	24-in.	Sensitive drill press	E. L. Essley Machinery Corp.
1		Sensitive drill press	Manning, Maxwell & Moore
1		Feed drill	Manning, Maxwell & Moore
1		Drill press	Consolidated Mach. Tool Corp.
1	36-in. by 36-in by 12-ft.	Metal planer	Herberts Machinery & Supply Co.
1	24-in.	Pillar shaper	Harron, Richards & McCone Co.
1	24-in.	Crank shaper	Harron, Richards & McCone Co.
2	36-in.	Pillar shapers	Morton Manufacturing Co.
2	36-in.	Draw cut shapers	Morton Manufacturing Co.
1	26-in.	Crank slotter	T. C. Dill Machine Co.
1		Horizontal boring mill	Lucas Machine Tool Co.
1	42-in.	Boring mill	Consolidated Mach. Tool Corp.
1	50-in.	Vertical boring mill	Waterhouse & Lester Co.
1	96-in.	Boring mill	Herberts Machinery & Supply Co.
1	96-in.	Boring and turning mill	Herberts Machinery & Supply Co.
1	100-in.	Boring and turning mill	Herberts Machinery & Supply Co.
1		Drilling and boring machine	Niles-Bement-Pond Co.
1		Car brass boring machine	Ar-An-Ess Mfg. Co.
1		Horizontal milling machine	Marshall & Huschart Mchy. Co.
1		Milling machine	Brown & Sharpe Mfg. Co.
1		Milling machine	Harron, Richard & McCone Co.
1		Vertical milling machine	Harron, Richard & McCone Co.
1		Portable milling machine	E. L. Ruby
1		Die making machine	E. L. Essley Machinery Corp.
1		Broaching machine	Harron, Richard & McCone Co.
1		Piston rod grinding machine	Landis Tool Works
3		Grinding machines	Heald Machine Co.
1		Radius link grinding machine	Manning, Maxwell & Moore
1	12-in. by 40-in.	Grinding machine	Harron, Richard & McCone Co.
1	84-in. by 23⅛-in.	Guide grinder	E. L. Essley Machinery Corp.
1	84-in by 24⅛-in.	Guide grinder	E. L. Essley Machinery Corp.
1		Surface grinding machine	Brown & Sharpe
1		Surface grinder	Herberts Machinery & Supply Co.
1		Single end wet emery grinder	Manning, Maxwell & Moore
12		Double end wet emery grinders	Marshall & Huschart Mchy. Co.
4		Double end dry emery grinders	Marshall & Huschart Mchy. Co.
1		Saw sharpener and grinder	Machinery Corp. of America
1		Band saw filing and setting mach.	E. L. Essley Machinery Corp.
2		Band saw sharpeners	Sam C. Rogers & Co.
1	3/32-in. to 4-in.	Drill grinder	Herberts Machinery & Sup. Co.
1		Cold saw	Niles-Bement-Pond Co.
1		Draw cut hack saw	Herberts Machinery & Sup. Co.
1	90-in.	Quartering machine	Niles-Bement-Pond Co.
1		Portable loco. cyl. boring bar	Manning, Maxwell & Moore
1		Portable loco. cyl. boring bar	Manning, Maxwell & Moore
1		Portable valve chamber boring bar	H. B. Underwood Corp.
1		Bolt cutter	Landis Machine Co.
1		Pipe cutting machine	Manning, Maxwell & Moore
1		Pipe machine	E. L. Essley Machinery Corp.
1		Pipe threading machine	E. L. Essley Machinery Corp.
1		Pipe threading machine	H. Channon Co.
3		Crank pin presses	Watson-Stillman Co.
1	1,500-lb.	Steam hammer	Niles-Bement-Pond Co.
1	4,000-lb.	Double frame hammer	Niles-Bement-Pond Co.
1	3½-in.	Forging machine	Ajax Manufacturing Co.
1		Punching machine	Herberts Machinery & Sup. Co.
1	42-in.	Squaring shear	E. L. Essley Machinery Corp.
1	8-ft.	Squaring shear	E. L. Essley Machinery Corp.
1		Circular shear	E. L. Essley Machinery Corp.
1		Staybolt nipper	Jos. T. Ryerson & Son
2		Cornice brakes	Louis G. Henes
1		Safe end cutter	Jos. T. Ryerson & Son
1		Auto. safe end cut off machine	Jos. T. Ryerson & Son
2		Flue cutters	Jos. T. Ryerson & Son
2		Flue swedging machines	Jos. T. Ryerson & Son
4		Flue welding machines	Jos. T. Ryerson & Son
1		Flue welding machine	Thomson Electric Welding Co.
2		Saw and tube expanders	Jos. T. Ryerson & Son
2	24-ft.	Flue rattlers	Baird Pneumatic Tool Co.
2		Flue polishing machines	Peerless Surfacing Machine Co.
1		Flue polishing machine	Production Machine Co.
1		Hydraulic pipe bending machine	Watson-Stillman Co.
1		Pipe bending machine	Watson-Stillman Co.
2		Adjustable bending machines	Herberts Machinery & Supply Co.
1		Pipe bending machine	Pedrick Tool & Machine Co.
1	10-ft.	Plate flanging clamp	Consolidated Mach. Tool Corp.
1	20-ft.	Plate flanging clamp	Consolidated Mach. Tool Corp.
1	1¼-in. by 30-in.	Roll forming machine	Peck, Stow & Wilcox Co.
1	4-in. by 60-in.	Roll forming machine	Smith-Booth-Usher Co.
1		Angle iron bending roll	Miles Machinery Co.
1		Brake and folding machine	E. L. Essley Machinery Corp.
1		Power mortiser	American Wood Working Mchy. Co
1	24-in. by 7-ft.	Single surfacer	Eby Machinery Co.
1	24-in.	Swing cut-off saw	J. A. Fay & Egan Co.
1	36-in.	Hand feed rip saw	J. A. Fay & Egan Co.
1	16-ft.	Rip and cut-off saw	Oliver Machinery Corp.
1		Rip and cut-off saw	Greenlee Bros. Co.
1		Rip and cut-off saw	Oliver Machinery Co.
1		Band resaw stretcher and shear	Machinery Corp. of America
1	4-sided	Molder	J. A. Fay & Egan Co.
1		Drum and disk sander	J. A. Fay & Egan Co.
1		Sand blast equipment	Kirk & Blum Manufacturing Co.

Atlanta & West Point

No.	Size and capacity	Type of machine	Builder or dealer
1	2¼-in. by 24-in.	Turret lathe	Jones & Lamson Mach. Co.
1	42-in.	Band saw	Manning, Maxwell & Moore
1		Duplex adjust. bending mach.	James R. Kerling

Atlantic City Railroad

No.	Size and capacity	Type of machine	Builder or dealer
1	20-in.	Vertical drill press	Rockford Machine Tool Co.

Atlantic Coast Line

No.	Size and capacity	Type of Machine	Builder or dealer
1	14-in. by 6-ft.	Portable lathe	Bradford Machine Tool Co.
1	34-in.	Drill press	W. F. & John Barnes Co.
1	34-in.	Drill press	W. F. & John Barnes Co.
1	36-in. by 42-in. by 8-ft.	High speed planer	Jos. T. Ryerson & Son
1	30-in. by 30-in. by 16-in.	Slab miller	Ingersoll Milling Mach. Co.
1		Universal grinder	Gallmeyer & Livingston Co.
1		Drill grinder	Wm. Sellers & Co.
1		Cylinder boring bar	H. B. Underwood Corp.
1		Pipe cutting machine	Walworth Manufacturing Co.
1	6-spindle	Staybolt machine	Harrington Co.
1		Pneumatic mud ring riveter	W. F. Allen & Co.
1	1-in.	Lattice riveter	Manning, Maxwell & Moore
1		Portable riveter	W. F. Allen & Co.

Baltimore & Ohio

No.	Size and capacity	Type of machine	Builder or dealer
1		Journal truing lathe	Manning, Maxwell & Moore
1		Axle lathe	Betts Machy. Co.
1	16-in. by 6-ft.	Engine lathe	Kemp Machy. Co.
1		Heavy duty engine lathe	Aumen Machy. Co.
1	42-in.	Turret lathe	Bullard Mach. Tool Co.
1		Radial drill	Sherritt & Storer Co., Inc.
1	20-in.	Upright drill press	Kemp Machy. Co.
1		Radial drill press	Aumen Machy. Co.
2		Drill presses	Colburn Mach. Tool Co.
1		Self centering machine	Laughlin & Barney Co.
2	28-in.	Columbia crank shapers	Manning, Maxwell & Moore
3		Car wheel boring mills	Wm. Sellers & Co.
1		Reseating machine	Lagonda Manufacturing Co.
1		Guide bar grinder	Sherritt & Storer Co.
1		Tool Grinder	Wm. Sellers & Co.
1		Twist drill grinder	Sherritt & Storer Co.
1		Drill grinder	Niles-Bement-Pond Co.
1		Universal grinder	Kemp Mach. Co.
1		High speed power saw	Aumen Machy. Co.
1		High speed metal saw	L. A. Benson Co.
1		Metal cutting saw	Fairbanks, Morse & Co.
1		Cylinder boring bar	Manning, Maxwell & Moore
1	4½-in. by 6-ft.	Portable boring bar	Manning, Maxwell & Moore
1		Portable crank pin truing mach.	H. B. Underwood Corp.
4		Dome facing machines	Manning, Maxwell & Moore
3	1-in.	National bolt cutters	Manning, Maxwell & Moore
1	4-spindle	Bolt turning machine	Wm. H. Foster Co.
1		Pipe threading machine	L. A. Benson Co.
1		Pipe machine	Jarecki Manufacturing Co.
1	Large	Rip saw	J. A. Fay & Egan Co.
1		Cut-off saw	J. A. Fay & Egan Co.
1		Tochey timber dapper	National Con. Mach. Co.

Bangor & Aroostook

No.	Size and capacity	Type of machine	Builder or dealer
1	36-in. by 12-ft.	Heavy pattern planer	Manning, Maxwell & Moore
1	11/32-in.	Bench drill	Manning, Maxwell & Moore
1		Floor grinder	Hisey-Wolf Machine Co.
1	1-in.	Vertical punch and shear	Manning, Maxwell & Moore

Boston & Albany

No.	Size and capacity	Type of machine	Builder or dealer
1	13½-in.	Axle lathe	Betts-Bridgeford Co.
1	14½-in.	Engine lathe	American Tool Works Co.
1	24-in. by 7-ft.	Engine lathe	Bradford Machine Tool Co.
2	36-in. by 7-ft.	Engine lathes	Bradford Machine Tool Co.

No.	Size and capacity	Type of machine	Builder or dealer
1		Rotary valve planer	H. B. Underwood Corp.
1	30-in.	Rotary valve seat planer	H. B. Underwood Corp.
1	36-in.	Draw cut shaper	Morton Manufacturing Co.
1	32-in.	Shaper	Gould & Eberhardt
1	24-in	Shaper	Stockbridge Machine Co.
1	24-in.	Shaper	Gould & Eberhardt
1	18-in.	Slotter	Dill Machine Co.
1		Horizontal boring machine	Lucas Machine Tool Co.
1	No. 6	Double emery grinder	Bridgeport Safety Em'y Wheel Co.
1		Double floor grinder	Bridgeport Safety Em'y Wheel Co.
2		Universal knife grinders	American Woodworking Mach. Co.
1		Metal cutting band saw	
1	500-lb.	Bradley hammer	Manning, Maxwell & Moore
1	2½-in.	Forging machine	Ajax Manufacturing Co.
1		Forging machine	Ajax Manufacturing Co.
1		Squaring shear	Manning, Maxwell & Moore
1	8-ft.	Flanging clamp	Wickes Brothers
1		Vertical staybolt drill	Manning, Maxwell & Moore
1		Vertical boring machine	Greenlee Bros., & Co.
1		Planer and timber sizer	Yates Machine Co.

Central Railroad of New Jersey

No.	Size and capacity	Type of machine	Builder or dealer
1	4½-in.	Turret lathe	Warner & Swasey Co.
1	7-in.	Precision cutter grinder	W. O. Barnes & Co.
1	100-ton	Bushing press	Watson-Stillman Co.
1	5¾-in.	Pneumatic tube welding mach.	Draper Manufacturing Co.

Chesapeake & Ohio

No.	Size and capacity	Type of machine	Builder or dealer
1	16-in. by 8-ft.	Engine lathe	Hendey Machine Co.
2	42-in.	Vertical turret lathes	Bullard Machine Tool Co.
1	2¼-in. by 24-in.	Flat turret lathe	Warner & Swasey Co.
1	42-in.	Car Wheel lathe	Wm. Sellers & Co.
1	32-in. by 32-in. by 39½-in.	Planer	Newton Machine Tool Works
1	36-in.	Drawcut shaper	Morton Manufacturing Co.
1		Boring and facing machine	Wm. Sellers & Co.
1	16-in. by 8-in. by 4-in.	Slab mill	Goddard & Goddard
2	36-in. by 4-in.	Wet tool grinders	Diamond Machine Co.
1	2¾-in.	Drill pointing machine	Oliver Instrument Co.
1		Reamer and cutter grinder	Brown & Sharpe Mfg. Co.
1	3/32-in. to 3½-in.	Twist drill grinder	Wilmarth & Morman Co.
1	13-in. by 16-in.	Metal sawing machine	Peerless Machine Co.
2	6-in.	Power hack saws	Racine Tool & Machine Co.
1	90-in.	Wheel quartering machine	Niles-Bement-Pond Co.
1	12-in. by 18-in.	Crank pin turning machine	H. B. Underwood Corp.
3	100-ton	Hydraulic presses	Chambersburg Engineering Co.
1	1-in. to 4-in.	Pipe threading machine	Oster Manufacturing Co.
1	36-in.	Squaring shear	Niagara Punch & Shear Co.
2	4½-in by 8-in to 6-in. by 11-in.	Journal bearing machine	Ar-An-Ess Mfg. Co.
4	½-in. to 6-in.	Tube cutting machines	Jos. T. Ryerson & Son
2	96-in.	All steel bending brakes	Dreis & Krump Mfg. Co.
1		Adjusting machine	Walter Stock Adj. Mach. Co.

Chicago & Alton

No.	Size and capacity	Type of machine	Builder or dealer
1	¼-in. to 3-in.	Pipe cutting machine	Jarecki Manufacturing Co.

Chicago, Burlington & Quincy

No.	Size and capacity	Type of machine	Builder or dealer
1	16-in. to 20-in.	Engine, lathe	
2		Vertical drill presses	
1		Car wheel boring mill	
3		Car brass boring machines	
1		Splice bar milling machine	
3		Dry grinders	
1		Cutter grinder	
1		Bolt threading machine	
1		Pipe threading machine	
1		Helve hammer	
2		Bulldozers	
1		Bolt straightener	
2		Punching machines	
4		Shears	
1		Portable shear	
1		Squaring shear	

No.	Size and capacity	Type of machine	Builder or dealer
1	42-in.	Car wheel lathe	Wm. Sellers & Co.
1	21½-in.	Turret lathe	Warner & Swasey Co.
2	5-ft.	Radial drills	American Tool Works Co.
1	32-in.	Shaper	Stockbridge Machine Co.
1	2-in.	Triple head bolt cutter	Acme Machine Co.
1	2¼-in.	Triple head bolt cutter	Acme Machine Co.
1	75-ton	Hydraulic press	Chambersburg Engineering Co.
1		Punch	Long & Allstatter Co.
1		Shear	Long & Allstatter Co.
1		Electric flue welder	Thomson Electric Welding Co.
1		Surfacer	J. A. Fay & Egan Co.

Boston & Maine

No.	Size and capacity	Type of machine	Builder or dealer
2		Double axle lathes	Manning, Maxwell & Moore
1	3-in. by 36-in.	Turret lathe	Jones & Lamson Mach. Co.
2	6-ft.	Radial drills	Thomson Co.
1	42-in.	Upright drill	Barnes Manufacturing Co.
1	30-in.	Morton draw cut shaper	Manning, Maxwell & Moore
2	40-in.	Car wheel borers	Manning, Maxwell & Moore
1		Driving box boring mill	Bullard Mach. Tool Co.
1		Cincinnati milling machine	Henry Prentiss Co.
1		Internal grinding machine	Heald Mach. Co.
1	5-valve	Valve finishing machine	Walter H. Foster Co.
1		Drill point grinder	Taylor Machine Co.
1	20-in.	Grinding wheel	Norton Co.
1	20-in.	Grinder	Norton Co.
1		Power hack saw	Taylor Mach. Co.
1	400-ton	Chambersburg wheel press	Manning, Maxwell & Moore
1	100-ton	Hydraulic driving box press	Bullard Mach. Tool Co.
1	¾-in.	Cross cutting shear	Long & Allstatter Co.
1	97-in.	Power squaring shear	Niagara Mach. & Tool Co.
1	36-in.	Punch and shear	Long & Allstatter Co.
1		Electric flue welder	Thomson Electric Weld. Co.
1		Adjusting machine	Walter Stock Adj. Mch. Co.
1	36-in.	Band saw	American Woodworking Mach. Co.

Canadian Pacific

No.	Size and capacity	Type of machine	Builder or dealer
1		Double car axle lathe	J. Bertram & Sons
1		Car axle lathe	Canadian Machy. Corp.
1	20-in. by 8-ft.	Engine lathe	Canadian Machy. Corp.
1	24-in. by 10-ft.	Engine lathe	J. Bertram & Sons
1	24-in. by 12-ft.	Engine lathe	Canadian Machy. Corp.
1	26-in. by 12-ft.	Engine lathe	Canadian Machy. Corp.
1	32-in. by 14-ft.	Engine lathe	J. Bertram & Sons
1	36-in. by 12-ft.	Engine lathe	Canadian Machy. Corp.
2	5-in.	Turret lathes	Alfred Herbert, Ltd.
1	42-in.	Vertical turret lathe	Bullard Mach. Tool Co.
1	54-in.	Vertical turret lathe	Bullard Mach. Tool Co.
1	42-in.	Car wheel lathe	J. Bertram & Sons
1	52-in.	Car wheel lathe	J. Bertram & Sons
1	30-in.	Vertical drill press	Canadian Machy. Corp.
1	36-in. by 18-ft.	Frog and switch planer	J. Bertram & Sons
4	32-in.	Shapers	J. Bertram & Sons
1	84-in.	Guide bar grinder	Bridgeport Safety Emery Wheel Co.
1	2-spindle	Vertical grinder	Beyer Peacock & Co.
1		Cylinder grinder	Churchill Mach. Tool Co., Ltd.
1		Surface grinder	Blanchard Mach. Co.
1		Double floor grinder	Ford-Smith Co.
1		Cutter and reamer grinder	Cincinnati Milling Mach. Co.
1		Hack saw	Racine Tool & Mach. Co.
1	2-in	Pipe cutting machine	A. R. Williams
1	100 ton	Axlebox press	J. Bertram & Sons
1		Bull lozer	Ajax Mfg. Co.
1		Double punch and shear	Craig & Donald
1		Power shear	Brown & Boggs
1	1-in. cap.	Flanging machine	McCabe Mfg. Co.
1	24-ft.	Flue cleaning machine	Draper Mfg. Co.

Central of Georgia

No.	Size and capacity	Type of machine	Builder or dealer
1	12-in.	Portable engine lathe	American Tool Works
1	90-in.	Journal turning lathe	Niles-Bement-Pond Co.
1	12-in.	Lathe	American Tool Works
1	16-in.	Toolroom lathe	Hendey Machine Co.
1	16-in.	Lathe	American Tool Works
1	18-in.	Lathe	American Tool Works
1	14-in.	Sensitive drill	
2		Bull riveters	
2		Pinch-bug riveters	
1		Rip saw	

Chicago Great Western

No.	Size and capacity	Type of machine	Builder or dealer
2	18-in. by 8-ft.	Engine lathes	Hill, Clarke & Co.
2	24-in. by 12-ft.	Engine lathes	Hill, Clarke & Co.
1	4-spindle	Valve grinding machine	Automatic Valve Grind. Mach. Co.
1		Tool post grinder	Western Electric Co.

Chicago, Indianapolis & Louisville

No.	Size and capacity	Type of machine	Builder or dealer
1	12-in. by 2-in. by 1-in.	Wet and dry grinder	Crerar-Adams & Co.
1	1/16-in. to ¼-in.	Metal cutting band saw	E. C. Atkins Co.
1	24-in	Cut-off saw	Van Camp Hardware & Iron Co.
1	36-in.	Car rip saw bench	Greenlee Bros., & Co.

Chicago, Rock Island & Pacific

No.	Size and capacity	Type of machine	Builder or dealer
3	14-in. by 13-in.	Axle lathes	Niles-Bement-Pond Co.
1	24-in. to 26-in.	Turret lathe	International Mach. Tool Co.
1	1¾-in., 4-spindle	Automatic screw machine	National Acme Co.
1	8-in.	Single spindle high speed drill	Sipp Machine Co.
1	3¾-in. by 7-in. and 4¼-in. by 8-in.	Car wheel boring machine	Davis Boring Tool Co.
1	4-in. by 8-ft.	Cylinder boring machine	H. B. Underwood Corp.
1	58-in. by 16-ft.	Horizontal rod milling machine	Niles-Bement-Pond Co.
2		Horizontal milling machines	Cincinnati Milling Mach. Co.
1	¼-in. to 2¾-in.	Automatic drill pointer	Oliver Instrument Co.
2	48-in., 400-ton	Car wheel presses	Niles-Bement-Pond Co.
1	38-in., 20-ton	Arbor press	Atlas Press Co.
1	1-in. to 2-in.	Pipe bending machine	H. B. Underwood Corp.
1	4-spindle	Car boring machine	Greenlee Bros. & Co.
1	14-in. by 16-in.	Car mortiser	Greenlee Bros. & Co.
1	1-in.	Mortising machine	Greenlee Bros. & Co.
1	5-in. by 20-in.	Cabinet tenoning machine	J. A. Fay & Egan Co.
1	36-in.	Automatic cut-off machine	Greenlee Bros. & Co.
1	42-in.	Band saw machine	J. A. Fay & Egan Co.
1	32-in.	Rip saw	Greenlee Bros. & Co.

Chicago & Western Indiana

No.	Size and capacity	Type of machine	Builder or dealer
1	3-ft.	Radial drill	American Tool Works
1		Vertical drill	Foote-Burt Co.
1	2-in.	Singlehead bolt threader	Landis Machine Co.
1	2-in.	Boring and mortising machine	Greenlee Bros. & Co.
1	36-in.	Cut-off saw	J. A. Fay & Egan Co.
1	30-in.	Rip saw	Greenlee Bros. & Co.

Cincinnati, Indianapolis & Western

No.	Size and capacity	Type of machine	Builder or dealer
1	96-in., 600-ton	Wheel press	Southwark Foundry & Machine Co.

Cincinnati Northern

No.	Size and capacity	Type of machine	Builder or dealer
1	21-in. by 10 ft.	Engine lathe	R. K. LeBlond Machine Tool Co.

Cleveland, Cincinnati, Chicago & St. Louis

No.	Size and capacity	Type of machine	Builder or dealer
2		Double head axle lathes	Niles-Bement-Pond Co.
1	20-in. by 10-ft.	Engine lathe	Cisco Machine Tool Co.
2	21-in. by 10-ft.	Engine lathes	R. K. LeBlond Machine Tool Co.
1	23-in. by 12-ft.	Engine lathe	R. K. LeBlond Machine Tool Co.
1	24-in. by 12-ft.	Engine lathe	Bradford Machine Tool Co.
1	24-in. by 12-ft.	Engine lathe	Lodge & Shipley Machine Tool Co.
1	2-in. by 24-in.	Flat turret lathe	Jones & Lamson Machine Co.
1	48-in.	Car wheel lathe	Niles-Bement-Pond Co.
1	42-in.	Car journal lathe	Niles-Bement-Pond Co.
2	5-ft.	Radial drills	Cincinnati-Bickford Tool Co.
2	5-ft.	Radial drills	Niles-Bement-Pond Co.
1	24-in. by 36-in.	Vertical drill press	Cincinnati-Bickford Tool Co.
1	24-in.	Vertical drill press	Aurora Tool Works
2	24-in. to 36 in.	Vertical drill presses	Cincinnati-Bickford Tool Co.
1	36-in.	Vertical drill press	Cincinnati-Bickford Tool Co.

Cleveland, Cincinnati, Chicago & St. Louis (Continued)

No.	Size and capacity	Type of machine	Builder or dealer
2	48-in.	Car wheel boring mills	Niles-Bement-Pond Co.
1	36-in. by 36-in. by 16-ft.	Planer type miller	Newton Mach. Tool Works
1	32-in.	Crank shaper	Cincinnati Shaper Co.
1	32-in.	Crank shaper	Gould & Eberhardt
1		Link grinder	Gisholt Mach. Co.
1	24-in. by 4-in.	Double end dry emery grinder	U. S. Electrical Tool Co.
5	18-in. by 3-in.	Double end dry floor grinders	U. S. Electrical Tool Co.
1		Cylinder head facing machine	H. B. Underwood Corp.
5	2-in.	Double head bolt cutters	Acme Machine Co.
1	3-in.	Single head bolt cutter	Landis Tool Co.
1	2½-in. to 12-in.	Pipe threading machine	Bignall & Keller Mfg. Wks.
1	½-in. to 4-in.	Pipe threading machine	Bignall & Keller Mfg. Wks.
1	750-ton	Four post hydraulic press	Southwark Foundry & Mach. Co.
1	600-ton, 48-in.	Car wheel press	Chambersburg Engineering Co.
1		Thoatless rotary shear	Marshalltown Mfg. Co.
1	16-gage, 18-in.	Square shear	Peck, Stow & Wilcox Co.
1	⅜-in. by 8-ft.	Power gap shear	Bertsch & Co.
1	36-in.	Automatic cut-off saw	J. A. Fay & Egan Co.
1	42-in.	Band saw	American Woodworking Mach. Co.
1	16-in.	Swing cut-off saw	American Woodworking Mach. Co.

Delaware & Hudson

No.	Size and capacity	Type of machine	Builder or dealer
1	20-in by 10-ft.	Engine lathe	American Tool Works Co.
1	28-in	Drill press	Barnes Machine Tool Co.
1	32-in.	Back gear shaper	Cincinnati Shaper Co.
1	16-in. by 2½-in. by 1½-in.	Double end grinder	Blount Machine Tool Co.

Delaware, Lackawanna & Western

No.	Size and capacity	Type of machine	Builder or dealer
1	6-in. by 11-ft.	Putnam double axle lathe	Manning, Maxwell & Moore
2	6-in. by 11-ft.	Journal and axle lathes	Niles-Bement-Pond Co.
1	42-in.	Vertical turret lathe	Bullard Machine Tool Co.
2	24-in.	Vertical drills	Defiance Machine Works
2	48-in.	Car wheel borers	Niles-Bement-Pond Co.
1	30-in.	Combination punch and shear	Henry Pels & Co.
1	⅜-in. to 2-in.	Pipe threading machine	Oster Manufacturing Co.
1	800-ton	Driving wheel press	Chambersburg Engineering Co.
1	3,400-lb.	Steam hammer	Chambersburg Engineering Co.

Denver & Intermountain

No.	Size and capacity	Type of machine	Builder or dealer
1	16-in.	Circular wood saw	J. A. Fay & Egan Co.

Denver & Rio Grande Western

No.	Size and capacity	Type of machine	Builder or dealer
1	8-in. by 18-in.	Power hack saw	Robertson Machine & Foundry Co.
1	½-in. to 2-in.	Pipe cutter	Geist Manufacturing Co.
1	½-in. to 2-in.	Pipe threading machine	Landis Machine Co.
2	250-lb.	Power hammers	Moloch Co.
2		Alligator shears	Doelger & Kirsten
1	2-in.	Washer press	Southwark Foundry & Mach'y Co.
1	16-in.	Variety saw	Greenlee Bros. & Co.
1	36-in.	Patternmaker's speed lathe	Oliver Machinery Co.

Detroit, Toledo & Ironton

No.	Size and capacity	Type of machine	Builder or dealer
1		Car wheel grinding machine	Norton Co.

Duluth, Missabe & Northern

No.	Size and capacity	Type of machine	Builder or dealer
1	21-in.	Vertical drill	Richards Mach. Co.
2	10-in.	Double bench grinders	U. S. Electrical Tool Co.
1	36-in.	Shear	Niagara Machine & Tool Co.
1	1½-in.	Mortiser	J. A. Fay & Egan Co.
1	6E	Fox trimmer	J. A. Fay & Egan Co.
1		Belt sander	J. A. Fay & Egan Co.
1		Hair and moss picker	F. Franke & Co.

Great Northern

No.	Size and capacity	Type of machine	Builder or dealer
1	18-in. by 10-ft.	Engine lathe	Lodge & Shipley Mach. Tool Co.
1	3¼-in. by 28-in.	Flat turret lathe	Cincinnati Acme Tool Co.
1		Driving box boring mill	Bullard Machine Tool Co.
1		Car wheel boring mill	Wm. Sellers & Co.
1	600-ton	Driving wheel press	Watson-Stillman Co.

Gulf Coast Lines

No.	Size and capacity	Type of machine	Builder or dealer
1	32-in.	Heavy duty shaper	Columbia Mach. & Tool Co.
1	50-ton	Forcing and bending press	Chambersburg Engineering Co.

Gulf Mobile & Northern

No.	Size and capacity	Type of machine	Builder or dealer
1	36-in. by 36-in. by 10-ft.	Planer	Niles-Bement-Pond Co.

Hocking Valley

No.	Size and capacity	Type of machine	Builder or dealer
1	42-in.	Vertical turret lathe	Bullard Machine Tool Co.
1	22-in.	Sliding head vertical drill press	Aurora Tool Works
1	8-spindle	Valve grinder	Automatic Valve Grind. Mach. Co.
1	2-in.	Bolt threading machine	Landis Mach. Co.
1	100-ton	Hydraulic forcing press	Hydraulic Press Mfg. Co.
1	36-in. by 18-ft.	Medium pattern lathe	American Tool Works Co.

Illinois Central

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Journal lathe	Niles-Bement-Pond Co.
1		Semi-auto valve finishing machine	Walter H. Foster Co.

Kansas City Southern

No.	Size and capacity.	Type of machine	Builder or dealer
1		Journal and axle lathe	Niles-Bement-Pond Co.
1	16-in. by 8-ft.	Portable engine lathe	American Tool Works Co.
1	18-in. by 10-ft.	Engine lathe	Lodge & Shipley Mach. Tool Co.
1	24-in. by 8-ft.	Engine lathe	Boye & Emmes Mach. Tool Co.
2	27-in. by 16-ft.	Engine lathes	Lodge & Shipley Mach. Tool Co.
1		Turret lathe	Warner & Swasey
1		Hexagon turret lathe	Warner & Swasey
1	54½-in.	Vertical turret lathe	Bullard Mach. Tool Co.
1	54-in.	Tire turning lathe	Manning, Maxwell & Moore
1	5-ft.	Plain radial drill	American Tool Works Co.
1	6-ft.	Radial drill	Dreses Mach. Tool Co.
1	6-ft.	Universal radial drill	Dreses Mach. Tool Co.
1		Heavy duty upright drill	Baker Brothers, Inc.
1	42-in. by 42-in. by 16-ft.	Planer	G. A. Gray Co.
1	28-in.	Shaper	Columbia Mach. Tool Co.
1	32-in.	Shaper	Columbia Mach. Tool Co.
1	48-in.	Car wheel boring machine	Manning, Maxwell & Moore
1		Horizontal boring and mill. mach.	Giddings & Lewis Mach. Tool Co.
1		Milling machine	Cincinnati Milling Mach. Co.
1		Internal grinding machine	Heald Mach. Co.
1	30-in.	Guide grinder	Diamond Mach. Co.
2		Floor grinders	Hisey-Wolf Mach. Co.
6		Bench grinders	Hisey-Wolf Mach. Co.
2		Pipe threading machines	Landis Mach. Co.
1		Triple head bolt threader	Landis Mach. Co.
1	400-ton, 48-in.	Wheel press	Niles-Bement-Pond Co.
2	100-ton	Hydraulic bushing presses	Chambersburg Engineering Co.
1	1,500-lb.	Single frame steam hammer	Chambersburg Engineering Co.
1	5,000-lb.	Single frame steam hammer	Chambersburg Engineering Co.
1	3-in.	Forging machine	National Machy. Co.
1	2-in. by 5-in.	Guillotine type bar shears	Long & Allstatter Co.
1		Flue swedging machine	Draper Mfg. Co.
1		Flanging machine	McCabe Mfg. Co.
1	30-in.	Double end patternmaker's lathe	Oliver Mach. Co.
1		Pattermaker's hand carving mach.	

Lake Superior & Ishpeming

No.	Size and capacity	Type of machine	Builder or dealer
1		Grinding machine	Western Stores Co.

Duluth, South Shore & Atlantic

No.	Size and capacity	Type of machine	Builder or dealer
2		Engine lathes	Lodge & Shipley Mach. Tool Co.
1	28-in.	Drill press	Cincinnati-Bickford Tool Co.
1	No. 2.	Milling machine	Cincinnati Milling Mach. Co.

East Broad Top

No.	Size and capacity	Type of machine	Builder or dealer
1	8-in. by 8-in.	Metal cutting machine	Racine Tool & Machine Co.

Elgin, Joliet & Eastern

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 2	Eye-bolt machine	Williams, White & Co.

Erie

No.	Size and capacity	Type of machine	Builder or dealer
1		Center drive axle lathe	Niles-Bement-Pond Co.
2	16-in. by 8-ft.	Engine lathes	Davis Machine Tool Co.
1	Type B-6	Bench lathe	Dalton Co.
1	33-in.	Drill press	J. E. Snyder Co.
2	¾-in.	Sensitive drill presses	Sipp Mach. Tool Co.
1	20-in.	Shaper	Gould & Eberhardt
2	24-in.	Shapers	Gould & Eberhardt
1	48-in.	Car wheel borer	Niles-Bement-Pond Co.
2	3½-in. by 7-ft.	Valve chamber boring bars	H. B. Underwood Corp.
1		Universal miller	Cincinnati Milling Mach. Co.
1		Milling machine	Cincinnati Milling Mach. Co.
2	2¼-in.	Twist drill grinders	Oliver Mach. Co.
1		Band saw filer and setter	Black Diamond Saw & Mach. Wks.
1	18-in.	Swing frame grinding machine	Excelsior Tool & Mach. Co.
1	1¼-in.	Double head bolt threader	Landis Machine Co.
1	½-in. to 4-in. No. 304 B	Pipe threading machine	Oster Mfg. Co.
1	No. 15	Arbor press	Greenerd Co.
1	100-ton	Bushing press	Chambersburg Engineering Co.
1	500-lb.	Motor driven blacksmith hammer	Blacker Engineering Co.
1	No. 45	Slitting shear	Niagara Mach. & Tool Wks.
1	42-in.	Squaring shear	Peck Stow & Wilcox Co.
1	1-in. to 2½-in.	Electric flue welding machine	Thomson Elec. Weld. Co.
1	8-in. by 10-in.	Compression riveter	Allen & Co.
1	¼-in. to ¾-in.	Hollow chisel mortiser	Greenlee Bros. & Co.
1	24-in.	Hand jointer and planer	J. A. Fay & Egan Co.
1	4-in. by 7½-in.	Tenoning machine	Greenlee Bros. & Co.
1	20-in.	Variety saw	Greenlee Bros. & Co.
1	42-in.	Band saw	J. A. Fay & Egan Co.

Florida East Coast

No.	Size and capacity	Type of machine	Builder or dealer
1	21-in. by 10-ft.	LeBlond engine lathe	Niles-Bement-Pond Co.
1	27-in. by 14-ft.	LeBlond engine lathe	Niles-Bement-Pond Co.
1	28-in.	Turret lathe	Gisholt Machine Co.
1	36-in.	Vertical turret lathe	Bullard Mach. Tool Co.
1	3-in. by 36-in.	Flat turret lathe	Jones & Lamson Mach. Co.
1	32-in.	Crank planer	Consolidated Mach. Tool Co.
4	26-in.	Stockbridge crank shapers	Niles-Bement-Pond Co.
1		Grand Rapids drill grinder	Niles-Bement-Pond Co.
3	2-in.	Triple head threading machines	Landis Mach. Co.
1	4-in.	Pipe threader and cutter	Landis Mach. Co.
1	32-in.	Aurora drill press	Niles-Bement-Pond Co.
1	100-ton	Forcing and bending press	Watson-Stillman Co.

Fort Worth & Denver City

No.	Size and capacity	Type of machine	Builder or dealer
1	3-in. by 36-in.	Flat turret lathe	Jones & Lamson Mach. Co.
1	28-in.	Drill press	Barnes Drill Co.
2	No. 121	Dry grinders	Ransom Mfg. Co.
1	No. 585	Oilstone tool grinder	Oliver Machinery Co.
1	36-in., No. 10	Band saw	American Wood Working Mach. Co.
1	38-in.	Band and resaw mach.	American Wood Working Mach. Co.

Georgia, Florida & Alabama

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 515	Universal wood worker	J. A. Fay & Egan Co.

Lehigh & New England

No.	Size and capacity	Type of machine	Builder or dealer
1	16-in. by 6-ft.	Engine lathe	Lodge & Shipley Mach. Tool Co.
1	20-in. by 10-ft.	Engine lathe	Lodge & Shipley Mach. Tool Co.
1		Turret lathe	Warner & Swasey Co.
1	28-in.	Vertical drill	Superior Machine Tool Co.
1	36-in. by 36-in. by 10-ft.	Gray planer	Swind Machinery Co.
1	28-in.	Heavy duty shaper	Ohio Machine Tool Co.

Lehigh Valley

No.	Size and capacity	Type of machine	Builder or dealer
1		Combination journal axle lathe	Niles-Bement-Pond Co.
1	90-in.	Journal turning lathe	Manning, Maxwell & Moore
2	18-in. by 10-ft.	Screw cutting engine lathe	Manning, Maxwell & Moore
2	20-in. by 12-ft.	Screw cutting engine lathe	Manning, Maxwell & Moore
1	23-in. by 12-ft.	LeBlond engine lathe	Niles-Bement-Pond Co.
1	42-in. by 16-ft.	Screw cutting engine lathe	Manning, Maxwell & Moore
1	90-in.	Driving wheel lathe	Wm. Sellers & Co.
1		Universal turret lathe	Foster Machine Co.
1	3½-in. by 40-in.	Flat turret lathe	Manning, Maxwell & Moore
1	54-in.	Vertical turret lathe	Bullard Machine Tool Co.
1	42-in.	Vertical turret lathe	Bullard Machine Tool Co.
1	6-ft.	Radial drill	Niles-Bement-Pond Co.
4	5-ft.	Dreses radial drills	Manning, Maxwell & Moore
3	32-in.	Crank planers	Consolidated Machine Tool Co.
3	38-in.	Crank planers	Consolidated Machine Tool Co.
4	24-in.	Stockbridge crank shaper	Niles-Bement-Pond Co.
1	36-in.	Draw cut shaper	Morton Manufacturing Co.
1	48-in.	Car wheel boring mill	Wm. Sellers & Co.
1		Journal boring machine	Ar-An-Ess Mfg. Co.
1		Drill grinder	Oliver Instrument Co.
1	3½-in.	Flue and pipe bending machine	Baird Pneumatic Tool Co.
1	¾-in.	Plate flanging machine	McCabe Manufacturing Co.
1		Adjusting machine	Walter Stock Adjusting Mach. Co.
1		Thomson flue welder	Sherritt & Storer Co.
1	14-gage	Cornice brake	Peck, Stow & Wilcox Co.

Long Island

No.	Size and capacity	Type of machine	Builder or dealer
2	20-in. by 8-ft.	Engine lathes	Boye & Emmes Machine Tool Co.
3	23-in. by 12-ft. T3	Heavy duty engine lathes	R. K. LeBlond Machine Tool Co.
1	5-ft.	Radial drill	American Tool Works Co.
1	24-in. by 24-in. by 24-in.	Crank planer	Woodward & Powell Machine Co.
1	20-in.	High duty shaper	Gould & Eberhardt
1	2-in	Double head bolt cutter	Williams Tool Corp.
1	150-ton	Horizontal forcing press	Watson-Stillman Co.
1		Blacksmith hammer	Blacker Engineering Co.
1	No. 6-E 18-in.	Squaring shear	Niagara Machine & Tool Wks.
1	No. 206	Power bending brake	Eres & Krump Manufacturing Co.

Los Angeles & Salt Lake

No.	Size and capacity	Type of machine	Builder or dealer
1	14-in. by 8-ft.	Tool room lathe	Manning, Maxwell & Moore
2	14-in. by 8-ft.	Monarch portable lathes	Herberts Machinery & Supply Co.
2	18-in. by 10-ft.	Monarch lathes	Herberts Machinery & Supply Co.
1	24-in. by 12-ft.	Monarch lathe	Herberts Machinery & Supply Co.
1	42-in. by 16-ft.	Betts-Bridgeford engine lathe	Herberts Machinery & Supply Co.
1	9¼-in.	Gisholt turret lathe	Herberts Machinery & Supply Co.
1	42-in.	Bullard vertical turret lathe	Harron, Rickard & McCone
1		Universal turret lathe	Smith-Booth-Usher Co.
1	6-ft.	Radial drill	Herberts Machinery & Supply Co.
1	5-ft.	Radial drill	Herberts Machinery & Supply Co.
1	34-in.	Sliding head drill press	Manning, Maxwell & Moore
1	42-in.	Sliding head drill press	Manning, Maxwell & Moore
2	½-in.	Ireland Clifford drill presses	Herberts Machinery & Supply Co.
2	¾-in.	Sensitive drill presses	Manning, Maxwell & Moore
1	24-in. by 24-in.	Crank planer	Manning, Maxwell & Moore
1	36-in.	Draw-cut shaper	Morton Manufacturing Co.
1	32-in.	Cincinnati Climax shaper	Herberts Machinery & Supply Co.
1	8-ft.	Betts vertical boring mill	Herberts Machinery & Supply Co.
1	24-in.	Betts slotting machine	Herberts Machinery & Supply Co.
1		Radius planing attachment	Herberts Machinery & Supply Co.
1		Sundstrand radius grinder	Herberts Machinery & Supply Co.
1	15-in. by 15-in. by 8-in.	Norton surface grinder	Herberts Machinery & Supply Co.
8	5-hp.	Grinding machines, dry	Herberts Machinery & Supply Co.
1		Wilmarth & Morman tool grinder	Herberts Machinery & Supply Co.
2		Racine metal cutting machines	Eccles & Davies

Los Angeles & Salt Lake (Continued)

No.	Size and capacity	Type of machine	Builder or dealer
1	6-in. by 10-ft.	Portable boring bar	Herberts Machinery & Supply Co.
1	1½-in.	Landis bolt threading machine	Herberts Machinery & Supply Co.
1	2-in.	Landis bolt threading machine	Herberts Machinery & Supply Co.
2	36-in. by 72-in., 50-ton	Draw forcing presses	Louis G. Henes
1	50-ton	Hydraulic bushing press	Manning, Maxwell & Moore
1	2,000-lb.	Chambersburg steam hammer	Manning, Maxwell & Moore
1	100-lb.	Bradley helve hammer	Herberts Machinery & Supply Co.
1	4-in.	Centering machine	Manning, Maxwell & Moore
1	1½-in to 6½-in.	Flue welding machine	Jos. T. Ryerson & Son
1	4-spindle	Vertical car borer	Greenlee Bros. & Co.
1		Surface planing machine	J. A. Fay & Egan Co.
1		Hollow chisel car mortiser	Greenlee Bros. & Co.
1	44-in.	Automatic cut-off saw	Greenlee Bros. & Co.
1	36-in.	Self-feed rip saw	Greenlee Bros. & Co.

Louisville & Nashville

No.	Size and capacity	Type of machine	Builder or dealer
2	16-in. by 8-ft.	Engine lathes	R. K. LeBlond Machine Tool Co.
1	18-in. by 8-ft.	Engine lathe	R. K. LeBlond Machine Tool Co.
1	18-in. by 10-ft.	Engine lathe	Boye & Emmes Mach. Tool Co.
4	20-in by 10-ft.	Engine lathes	R. K. Leblond Machine Tool Co.
1	21-in. by 12-ft.	Engine lathe	R. K. Leblond Machine Tool Co.
1	36-in. by 18-ft.	Engine lathe	Betts-Bridgeford Co.
1	42-in. by 19-ft.	Engine lathe	American Tool Works
1	4-ft.	Radial drill press	American Tool Works
2	21-in.	Drill presses	Cincinnati Bickford Tool Co.
1	28-in.	Drill press	Cincinnati Bickford Tool Co.
1	36-in.	Drill press	Cincinnati Bickford Tool Co.
1	42-in.	Drill press	Cincinnati Bickford Tool Co.
1		Drill press	Barnes Drill Co.
1	36-in. by 8-ft.	Planer	Cincinnati Bickford Tool Co.
1	36-in. by 36-in. by 12-ft.	Planer	Niles-Bement-Pond Co.
1	36-in. by 18-ft.	Planer	Cincinnati Bickford Tool Co.
1	20-in.	Shaper	Gould & Eberhardt
3	32-in.	Shapers	Ohio Machine Tool Co.
1	18-in.	Slotter	Niles-Bement-Pond Co.
1	62-in.	Boring mill	Niles-Bement-Pond Co.
1	66-in.	Boring and drilling machine	Niles-Bement-Pond Co.
1	73-in.	Boring and turning mill	Niles-Bement-Pond Co.
1		Link grinder	Gisholt Machine Tool Co.
1		Floor grinder	U. S. Electrical Tool Co.
1		Dry grinder	U. S. Electrical Tool Co.
1		Cutter and reamer grinder	R. K. LeBlond Machine Tool Co.
1	8-spindle	Valve grinder	Automatic Valve Grind'g Mach Co.
1	36-in.	Band saw	American Tool Works
2	6-in. by 6-in.	Power hack saws	Acme Machine Tool Co.
1	2-in.	Bolt cutter	Acme Machine Tool Co.
1	1½-in.	Bolt threading machine	Landis Machine Co.
1	2-in.	Bolt threading machine	Landis Machine Co.
1	600-ton	Wheel press	Chambersburg Engineering Co.
1	100-ton	Bushing press	Southwark Foundry & Machine Co.
1	800-lb.	Steam hammer	Niles-Bement-Pond Co.
1	48-in.	Punch	Cleveland Punch & Shear Co.
1		Punch and shear	Niagara Machine & Tool Works
1	1½-in. to 6½-in.	Flue welding machine	J. T. Ryerson & Son

Maine Central

No.	Size and capacity	Type of machine	Builder or dealer
1	13-in. by 6-ft.	Portable engine	Niles-Bement-Pond Co.
2	17-in. by 8-ft.	Engine lathes	J. T. Ryerson & Son
1	22-in. by 46-in. by 10-ft.	Gap lathe	Niles-Bement-Pond Co.
1	25-in. by 12-ft.	Engine lathe	J. T. Ryerson & Son
1	5-ft.	Radial drill	J. T. Ryerson & Son
1	20-in. by 8-ft.	Piston rod grinder	Landis Tool Co.
1	20-in. by 36-in. by 96-in.	Link grinder	Gisholt Machine Co.
1		Horizontal metal band saw	Napier Saw Works
1	100-ton	Hydraulic forcing press	Chambersburg Engineering Co.
1	12-in.	Buzz planer	J. A. Fay & Egan Co.
1	36-in.	Band saw	J. A. Fay & Egan Co.

Maryland & Pennsylvania

No.	Size and capacity	Type of machine	Builder or dealer
1	3-in. by 36-in.	Flat turret lathe	Jones & Lamson Mach. Co.
1		Single end punch and shear	Cleveland Punch & Shear Co.
1		Bending roll	Cleveland Punch & Shear Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	48-in.	Car wheel boring mill	Niles-Bement-Pond Co.
1	48-in.	Car wheel boring mill	Niles-Bement-Pond Co.
2		Universal milling machines	Cincinnati Milling Mach. Co.
1	54-in. by 30-in. by 16-ft.	Horizontal milling machine	Ingersoll Milling Mach. Co.
1	54-in.	Vertical milling machine	Ingersoll Milling Mach. Co.
2		Tool room milling machines	Brown & Sharpe Mfg. Co.
2		Internal grinder	Heald Machine Co.
1		Link radius grinders	H. G. Hammet
10		Double end emery grinder	Niles-Bement-Pond Co.
1		Universal double end emery grdr.	U. S. Elec. Tool Co.
2	1½-in.	Grinders	Cincinnati Milling Mach. Co.
3		Drill grinders	Wilmarth & Morman Co.
1		Universal grinder	Niles-Bement-Pond Co.
3		Oil stone tool grinders	Oliver Machinery Co.
2	26-in	Newton cold cut-off saws	Consolidated Machine Tool Corp.
1	32-in.	Newton cold cut-off saw	Consolidated Machine Tool Corp.
1		Hack saw	Atkins Co.
1	1½-in.	Double head bolt threader	National Mach. Co.
1	2-in.	Double head bolt threader	Landis Mach. Tool Co.
1	1½-in.	Double head bolt threader (belt)	National Mach. Co.
3	¼-in. to 2-in.	Double head pipe threader	Landis Mach. Tool Co.
1	¼-in. to 2-in.	Double head pipe threader	Oster Manufacturing Co.
4	1-in. to 4-in.	Double head pipe threaders	Oster Manufacturing Co.
2	48-in., 400-ton	Car wheel presses	Niles-Bement-Pond Co.
7	100-ton	Hydraulic bushing presses	Niles-Bement-Pond Co.
2		Power presses	Belt Slayman & Co.
1	5,000-lb.	Steam hammer	Chambersburg Engineering Co.
2		Triple gage punches	H. J. Pels & Co.
2		Power gap shears	Niagara Machine & Tool Wks.
4		Universal punch and shears	H. J. Pels Co.
1		Universal punch and shear	Buffalo Forge Co.
3	24½-in.	Double cylinder flue welders	J. T. Ryerson Co.
3	1½-in. to 3-in.	Auto. safe end cut-off machines	Jos. T. Ryerson & Son
3	2-in. to 6½-in.	Comb. hot saw and flue expanders	Jos. T. Ryerson & Son
2	¾-in.	Pneumatic flangers	McCabe Manufacturing Co.
2	6-in.	Bench hand planers	J. D. Wallace & Co.
3	7-in.	Universal bench saws	J. D. Wallace & Co.
2	18-in.	Bench band saws	J. D. Wallace & Co.
1	18-in.	Band saw	Oliver Machinery Co.
1	20-in.	Variety saw	J. A. Fay & Egan Co.
1	36-in.	Swing saw	Oliver Machinery Co.
1	36-in.	Band saw	J. A. Fay & Egan Co.
1	6-in.	Bench jointer	J. D. Wallace Co.

Nashville, Chattanooga & St. Louis

No.	Size and capacity	Type of machine	Builder or dealer
1	18-in. by 8-ft.	Engine lathe	Boye & Emmes Mach. Tool Co.
1	34-in.	Sliding head upright drill press	Barnes Drill Co.
1	28-in.	Crank shaper	Columbia Mach. Tool Co.
2	18-in. by 3-in.	Double end emery wheel grinders	Hisey-Wolf Mach. Co.
2		Drill grinders	Wilmarth & Morman Co.
1		Single end punch and shear	Hilles & Jones Co.
1	¾-in.	Pneumatic flanging machine	McCabe Manufacturing Co.

National Railways of Mexico

No.	Size and capacity	Type of machine	Builder or dealer
1	17-in. by 10-ft.	Engine lathe	Jos. T. Ryerson & Son
2	90-in.	Driving wheel lathes	Jos. T. Ryerson & Son
6		Universal hexagon turret lathes	Jos. T. Ryerson & Son
6		Geared head turret lathes	Jos. T. Ryerson & Son
6		Universal hexagon turret lathes	Jos. T. Ryerson & Son
3	20-in.	Rockwell drill presses	Jos. T. Ryerson & Son
1	18-in.	Portable valve seat planer	Jos. T. Ryerson & Son
1	28-in.	Portable valve seat planer	Jos. T. Ryerson & Son
2		Morton cylinder planers	Jos. T. Ryerson & Son
1	30-in.	Crank slotting machine	Jos. T. Ryerson & Son
1	42-in.	Colburn vertical boring mill	Jos. T. Ryerson & Son
2	48-in.	Light car wheel borers	Jos. T. Ryerson & Son
6		Pedestal milling machines	Jos. T. Ryerson & Son
1		Cold saw cutting off machine	Jos. T. Ryerson & Son
1	No. 1	Cylinder or dome facing machine	Jos. T. Ryerson & Son
2	No. 2	Cylinder or dome facing machines	Jos. T. Ryerson & Son
3	No. 2	Portable crank pin turn'g machines	Jos. T. Ryerson & Son
1	No. 3	Cylinder or dome facing machine	Jos. T. Ryerson & Son
2		Forbes hand threading machines	Jos. T. Ryerson & Son
1	400-ton	Vertical wheel press	Jos. T. Ryerson & Son
3	50-ton	Vertical bushing presses	Jos. T. Ryerson & Son
3	2,000-lb.	Erie forging hammers	Jos. T. Ryerson & Son
2	40-in.	Square and circular shears	Jos. T. Ryerson & Son
2		Combined punches and shears	Jos. T. Ryerson & Son

Michigan Central

No.	Size and capacity	Type of machine	Builder or dealer
1	24-in. by 14-ft.	Engine lathe	Lodge & Shipley Mach. Tool Co.
1	16-in.	Portable lathe	
1	30-in.	Turret lathe	Steinle Turret Mach. Co.
2	36-in.	Drill presses	Superior Mach. Tool Co.
1	3-spindle	Drill	Superior Mach. Tool Co.
1	36-in. by 36-in. by 12-ft.	Planer	Liberty Mach. Tool Co.
2	30-in.	Shapers	Ohio Machine Tool Co.
1	3-in. by 16-in.	Floor grinder	Fordsmith Machine Co.
1	3-in. by 18-in.	Grinder	Ransom Mfg. Co.
1		Drill grinder	Oliver Machy. Co.
1		Double end grinder	Ransom Mfg. Co.
1		Cylinder boring bar	H. B. Underwood Corp.
1	4-in.	Pipe threader	Oster Manufacturing Co.
1	1½-in.	Bolt threader	Landis Machine Co.
1	400-ton	Single end wheel press	Chambersburg Engineering Co.
3	100-ton	Bushing presses	Southwark Foundry & Mach. Co.
1	5-in. by 7-ft, 6-in.	Hydraulic bending press	Tinius Olsen Testing Mach. Co.
1	¾-in. by 2½-in.	Portable pipe bending mach.	H. B. Underwood Corp.
1		McCabe Flanger	McCabe Manufacturing Co.
1	1½-in.	Punch	Buffalo Forge Co.
1	1-in. by 4-in.	Bar shear	Buffalo Forge Co.
1	18-in. by 36-in.	Peerless squaring shear	Kutcheid Manufacturing Co.
1	22-gage	Lennox throatless shear	Marshalltown Manufacturing Co.
1		Flue polisher	Production Machine Co.
1		Flue welder	Thomson Electric Welder Co.
1	¼-in. by 8-ft. 1-in.	Chicago steel bending brake	Dries & Krump
1	36-in.	Heavy rip saw	Greenlee Bros. Co.
1		Wood milling machine	Oliver Machy. Co.
1	4-in.	Wood shaper	P. B. Yates Mach. & Tool Co.

Minneapolis, St. Paul & Sault Ste. Marie

No.	Size and capacity	Type of machine	Builder or dealer
3	18-in. by 8-ft	Engine lathes	Lodge & Shipley Mach. Tool Co.
2	12-in. by 1¼-in.	Tool grinders	U. S. Electrical Tool Co.

Missouri-Illinois

No.	Size and capacity	Type of machine	Builder or dealer
1		Mahrvel power hack saw	Crerar Adams & Co.
1	100-ton	Hydraulic press	Lourie Hydraulic Mfg. Co.

Missouri-Kansas-Texas

No.	Size and capacity	Type of machine	Builder or dealer
1	36-in.	Aurora drill press	Niles-Bement-Pond Co.
1	26-in.	Crank shaper	Niles-Bement-Pond Co.
1		Oster pipe machine	Manning, Maxwell & Moore
1	2-in. by 30-in.	Stove and tin pipe former	Manning, Maxwell & Moore
1	36-in.	Keystone bar folder	Manning, Maxwell & Moore

Missouri Pacific

No.	Size and capacity	Type of machine	Builder or dealer
2	14-in. by 4-ft.	Engine lathes	Niles-Bement-Pond Co.
1	16-in. by 8-ft.	Engine lathe	Lehman Machine Co.
1	18-in. by 9-ft.	Engine lathe	Lehman Machine Co.
1	20-in. by 8-ft.	Engine lathe	American Tool Works
1	20-in. by 10-ft.	Engine lathe	American Tool Works
1	20-in by 10-ft.	Engine lathe	Lehman Machine Co.
2	24-in. by 5-ft.	Heavy duty engine lathes	American Tool Works
2	25-in. by 14-ft.	Geared head engine lathes	R. K. Le Blond Mach. Tool Co.
1	32-in. by 10-ft.	Heavy duty engine lathe	American Tool Works
4	36-in.	Vertical turret lathes	Bullard Machine Tool Co.
2	42-in.	Vertical turret lathes	Bullard Machine Tool Co.
2	3-in. by 36-in.	Flat turret lathes	Jones & Lamson Mach. Co.
2	3¼-in. by 24-in.	Flat turret lathes	Jones & Lamson Mach. Co.
1		Turret lathe	Warner & Swasey Co.
6	3-ft.	Heavy duty radial drills	American Tool Works
2	4-ft.	Heavy duty radial drills	American Tool Works
2	6-ft.	Heavy duty radial drills	American Tool Works
1	6-ft.	Heavy duty radial drill	Reed-Prentice Co.
1	One-spindle	Sensitive drill	C. G. Allen Co.
1	Two-spindle	Sensitive drill	C. G. Allen Co.
2	24-in. by 24-in. by 24-in.	Crank planers	Woodward & Powell Planer Co.
2	32-in.	Crank shapers	Gould & Eberhardt
1	18-in.	Slotter	T. C. Dill Mach. Co.
1	24-in.	Slotter	T. C. Dill Mach. Co.
2		Horizontal boring mills	Lucas Machine Tool Co.
1	44-in.	Vertical boring mill	Niles-Bement-Pond Co.

No.	Size and capacity	Type of machine	Builder or dealer
2		Bar folders	Jos. T. Ryerson & Son
2	37-in.	Slip roll formers	Jos. T. Ryerson & Son
2	Three-spindle	Vertical boring machines	Jos. T. Ryerson & Son
2		Hollow chisel mortisers	Jos. T. Ryerson & Son
2		Double cylinder surface planers	Jos. T. Ryerson & Son
2		Vertical car tenoning machines	Jos. T. Ryerson & Son
1		Rip saw	Jos. T. Ryerson & Son
2		Band sawing machines	Jos. T. Ryerson & Son
2		Crimping and beading machines	Jos. T. Ryerson & Son
2		Beading machines	Jos. T. Ryerson & Son
4		Burring machines	Jos. T. Ryerson & Son
2		Continuous feed glue jointers	Jos. T. Ryerson & Son
2		Right hand edgers	Jos. T. Ryerson & Son
2		Setting down machines	Jos. T. Ryerson & Son
2		Turning machines	Jos. T. Ryerson & Son

Nevada Northern

No.	Size and capacity	Type of machine	Builder or dealer
1	28-in.	Shaper	American Tool Works Co.

New York Central

No.	Size and capacity	Type of machine	Builder or dealer
2	16-in. by 4-ft.	Engine lathes	Niles-Bement-Pond Co.
2	16-in. by 8-ft.	Engine lathes	Manning, Maxwell & Moore
7	18-in. by 10-ft.	Engine lathes	Boye & Emmes Machine Tool Co.
1	20-in. by 8-ft.	Engine lathe	Boye & Emmes Machine Tool Co.
4	24-in. by 10-ft.	Engine lathes	Boye & Emmes Machine Tool Co.
1	24-in. by 10-ft.	Engine lathe	Cincinnati Lathe & Tool Co.
2	24-in. by 12-ft.	Engine lathes	Boye & Emmes Machine Tool Co.
1	30-in. by 7-ft.	Engine lathe	Manning, Maxwell & Moore
1	18-in.	Turret lathe	International Mach. Tool Co.
3	20-in.	Turret lathes	Manning, Maxwell & Moore
1	24-in.	Flat turret lathe	Bullard Machine Tool Co.
1	24-in.	Turret lathe	Manning, Maxwell & Moore
1	24-in.	Flat turret lathe	Manning, Maxwell & Moore
1	16-in.	Lathe	Manning, Maxwell & Moore
2	17-in.	Lathes	Niles-Bement-Pond Co.
1	24-in.	Lathe	Niles-Bement-Pond Co.
1	25-in.	Lathe	Niles-Bement-Pond Co.
1	26-in.	Lathe	Niles-Bement-Pond Co.
1	90-in.	Lathe	Niles-Bement-Pond Co.
1	3-ft.	Radial drill	Cincinnati-Bickford Tool Co.
3	4-ft.	Radial drills	Niles-Bement-Pond Co.
1	4-ft.	Radial drill	Manning, Maxwell & Moore
1	5-ft.	Radial drill	American Tool Works Co.
2	6-ft.	Radial drills	Niles-Bement-Pond Co.
1	16-in.	Drill press	Manning, Maxwell & Moore
1	26-in.	Vertical drill press	Niles-Bement-Pond Co.
1	20-in.	Sensitive drill press	Van Dyck Churchill Co.
1	30-in. by 120-in.	Planer	Niles-Bement-Pond Co.
1	48-in.	Planer	Niles-Bement-Pond Co.
1	60-in.	Planer	Niles-Bement-Pond Co.
1	32-in.	Shaper	Manning, Maxwell & Moore
1	32-in.	Shaper	Swing Mach. Co.
1	20-in.	Slotter	Wm. Sellers & Co.
1	25-in.	Rapid slotter	Jones Mach. Tool Works
1	42-in.	Vertical borer	Niles-Bement-Pond Co.
1	No. 5	Plain milling machine	Cincinnati Milling Mach. Co.
1	30-in by 36-in. by 12-ft.	Milling machine	Ingersoll Milling Machine Co.
1		Cotter and Key seat drill	Niles-Bement-Pond Co.
1	54-in.	Rotary milling machine	Ingersoll Milling Machine Co.
1		Milling machine	Henry Prentice & Co.
1	30-in.	Guide grinder	Manning, Maxwell & Moore
1	16-in. by 48-in.	Link grinder	Manning, Maxwell & Moore
1	12-in. by 36--in.	Grinder	Motch & Merryweather Mchy. Co.
1	16-in. by 72-in.	Plain grinder	Niles-Bement-Pond Co.
3	24-in. by 4-in.	Double emery grinders	Jos. T. Ryerson & Son
2	1/16-in. to 3-in.	Drill Grinders	Wm. Sellers & Co.
1		Drill grinder	Wilmarth & Morman Co.
1	6-in. wheel	Die sharpener	Manning, Maxwell & Moore
1	6⅝-in. by 6⅝-in.	Hack saw	Peerless Machine Co.
1	⅜-in. to 2-in.	Double head bolt cutter	Landis Machine Co.
1	½-in. to 2-in.	Double head bolt cutter	Landis Machine Co.
1	⅜-in. to 2-in.	Triple head bolt cutter	Landis Machine Co.
1	1½-in.	Triple head bolt threader	Landis Machine Co.
1	2-in.	Triple head bolt cutter	Landis Machine Co.
2	⅜-in. to 2-in.	Bolt threaders	Landis Machine Co.
1	¼-in. to 4-in.	Pipe threader	Motch & Merryweather Mchy. Co.
1	1½-in to 4-in.	Pipe threader	Motch & Merryweather Mchy. Co.
1	2½-in. to 8-in.	Pipe threader	Motch & Merryweather Mchy. Co.
1		Pipe threader	Manning, Maxwell & Moore

New York Central (Continued)

No.	Size and capacity	Type of machine	Builder or dealer
1	4-in.	Pipe threading and cutting mach.	Landis Machine Co.
2	50-ton	Bushing presses	Manning, Maxwell & Moore
1	50-ton	Bushing press	Hydraulic Press Mfg. Co.
3	100-ton	Bushing presses	Manning, Maxwell & Moore
1	300-ton	Crank pin press	Watson-Stillman Co.
1	500-lb.	Steam hammer	Manning, Maxwell & Moore
1	100-ton	Bulldozer	Manning, Maxwell & Moore
1	1½-in.	Forging machine	Cleveland Equipment & Engrg. Co.
1	1½-in.	Forging machine	Ajax Manufacturing Co.
2		Adjusting machines	Walter Stock Adjusting Mach. Co.
1	12-in.	Bar shear	Cleveland Punch & Shear Wks.
1		Niagara shear	Vandycke Churchill Co.
1	48-in. throat	Punch and shear	Cleveland Punch & Shear Wks.
1		Punch and shear	Long & Allstatter Co.
1	2½-in.	Flue welder	Thomson Electric Welding Co.
1	¾-in. plate	Pneumatic flanger	McCabe Mfg. Co.
1		Vertical disk and spindle sander	Oliver Manufacturing Co.
1		Automatic machine	
1		Car wheel lathe	
1		Lathe	
2		Radial drills	
2		Vertical drill presses	
1		Planer	
2		Crank planers	
1		Shaper	
2		Horizontal boring machines	
6		Cylinder boring mills	
2		Universal milling machines	
1		Vertical milling machine	
3		Rod grinding machines	
3		Double end emery grinders	
1		Double end floor grinder	
6		Lapping machines	
2		Cylinder facing machines	
1		Bolt altering machine	
1		Bar turning machine	
1		Staybolt machine	
2		Pipe threading machines	
6		Wheel presses	
1		Straightening press	
1		Bolt straightening hammer	
1		Shear	
1		Stock adjusting machine	
1		Single cylinder surfacer	

New York, Chicago & St. Louis

No.	Size and capacity	Type of machine	Builder or dealer
1	18-in.	Libby turret lathe	International Mach. Tool Co.
1	21-in.	Engine lathe	R. K. LeBlond Mach. Tool Co.
1	30-in.	Engine lathe	American Tool Works Co.
1	3-in. by 18-in.	Grinder	Hisey-Wolf Mach. Co.
1	54-in.	Vertical boring mill	Bullard Mach. Tool Co.
1	4½-in. by 8-ft.	Cylinder boring bar	H. B. Underwood Corp.
1	1½-in., 3-head	Staybolt cutter	Landis Mach. Co.
1	1¼-in.	Horizontal flange punch	Cleveland Punch & Shear Co.
1	¾-in.	Pneumatic flanging machine	McCabe Mfg. Co.

New York, New Haven & Hartford

No.	Size and capacity	Type of machine	Builder or dealer
1	2-in.	Die grinder	Acme Machinery Co.
1	6-in. by 6-in.	High speed metal cutting saw	Peerless Mach. Co.
2		Cylinder facing machines	H. B. Underwood Corp
2		Crank pin turning machines	E. J. Rooksby & Co.
1		Quintuple punch and shear	J. T. Ryerson & Son
4	3-in. by 12-in.	Tie and timber droppers	J. E. Tochey

New York, Ontario & Western

No.	Size and capacity	Type of machine	Builder or dealer
1	1½-in. to 6½-in.	Universal flue cleaning machine	J. T. Ryerson & Son

Northern Pacific

No.	Size and capacity	Type of machine	Builder or dealer
1		Journal truing lathe	W. F. Dunn Co.
1	2½-in. by 24-in.	Flat turret lathe	Jones & Lamson Machine Co.
1	1¼-in to 3-in.	Die grinder	Murchy Machine & Tool Co.
1		Wet and dry grinder	Cleveland Arm. Wks.
1	4-in. by 6-ft.	Portable boring bar	H. B. Underwood Corp.
2		Portable crank pin turners	H. B. Underwood Corp.
1		Pipe cutter	Murchy Machine & Tool Co.
1	2-in.	Double head pipe threading mach.	Landis Tool Co.
1	½-in. to 6-in.	Tube cutting machine	Jos. T. Ryerson & Son
2	No. 111	Flue welders	Johnston Manufacturing Co.
1	⅞-in. by 16-ft.	Plate bending rolls	Consolidated Mach. Tool Co.
1	24-ft.	Lumber trimmer with motor	American Saw Mill Co.

Norfolk & Southern

No.	Size and capacity	Type of machine	Builder or dealer
1	12-in. by 28-in.	Cylinder boring bar	H. B. Underwood Corp.

Norfolk & Western

No.	Size and capacity	Type of machine	Builder or dealer
3	14-ft.	Car axle lathes	Niles-Bement-Pond Co.
1		Journal and axle lathe	Niles-Bement-Pond Co.
2	16-in. by 8-ft.	Engine lathes	Bradford Machine Tool Co.
2	20-in. by 10-ft.	Engine lathes	Cisco Machine Tool Co.
2	21-in. by 10-ft.	Engine lathes	R. K. LeBlond Mach. Tool Co.
2	27-in. by 16-ft.	Engine lathes	Pittsburgh Mach. Tool Co.
1	36-in. by 16-ft.	Engine lathe	American Tool Works Co.
1	52-in. by 24-ft.	Engine lathe	Pittsburgh Mach. Tool Co.
1	90-in.	Driving wheel lathe	Niles-Bement-Pond Co.
1	28-in. to 42-in.	Car wheel lathe	Wm. Sellers & Co.
1	24-in.	Vertical turret lathe	Bullard Machine Tool Co.
1	30-in.	Horizontal turret lathe	Steinle Turret Mach. Co.
1	54-in.	Vertical turrent lathe	Bullard Mach. Tool Co.

Pittsburgh & Lake Erie

No.	Size and capacity	Type of machine	Builder or dealer
1	24-in. by 14-ft.	Engine lathe	Hendey Mach. Co.
1	16-in. by 8-ft.	Engine lathe	Springfield Mach. Tool Co.
1	2½-in. by 24-in.	Turret lathe	Jones & Lamson Mach. Co.
1	3½-in.	Turret lathe	Warner & Swasey Co.
1	3-ft.	Radial drill	American Tool Works
1	⅛-in. by ½-in.	Sensitive drill	Sipp Mach. Co.
1	¼-in. to 5⅛-in.	Bolt centering machine	
1	2-in. by 15-in.	Motor grinder	Heald Mach. Co.
1	¾-in.	Cold flanging press	McCabe Mfg. Co.

Quebec Central

No.	Size and capacity	Type of machine	Builder or dealer
1	4-ft., 6-in.	Radial drill	

Richmond, Fredericksburg & Potomac

No.	Size and capacity	Type of machine	Builder or dealer
1	36-in.	Engine lathe	American Tool Works Co.
1	36-in.	Engine lathe	Lodge & Shipley Mach. Tool Co.
1	4-ft.	Dreses radial drill	Manning, Maxwell & Moore
1	42-in.	Boring drill	Bullard Mach. Tool Co.
1	18-in. to 100-in.	Sundstand link grinder	Manning, Maxwell & Moore
1	4-in.	Pipe cutter and threader	Oster Manufacturing Co.
1	6-in.	Pipe cutter and threader	Oster Manufacturing Co.
1	24-in.	Punch and shear	J. T. Ryerson & Son
1		Bending roll	Segferts Sons

St. Louis-San Francisco

No.	Size and capacity	Type of machine	Builder or dealer
1		Double head axle lathe	
1	400-ton	Wheel press	
1	2,000-lb.	Steam hammer	

St. Louis Southwestern

No.	Size and capacity	Type of machine	Builder or dealer
2	16-in.	Tool room lathes	Lodge & Shipley Mach. Tool Co.
2	24-in.	Engine lathes	Lodge & Shipley Mach. Tool Co.
1	30-in.	Engine lathe	Boye & Emmes Mach. Tool Co.
2	20-in. by 40-in. by 10-ft.	Extension bed gap lathe	Rahn-Larmon Co.
1	50-in.	Sliding head vertical drill	W. F. & J. Barnes Co.
1	32-in.	Heavy duty back geared shaper	Columbia Mach. & Tool Co.
2	36-in.	Draw cut shapers	Morton Mfg. Co.
1	52-in. by 14-in. by 20-in.	Swing plain milling machine	Kearney-Trecker Corp.
1	12-in. by 32-in.	Universal grinding machine	Landis Mach. Co.
1	4½-in. to 8-in. by 16-in.	Internal and link grinder	Gisholt Mach. Co.
1	½-in. to 4-in.	Drill grinder	Wilmarth & Marmon Co.
1	¼-in. to 2½-in.	Drill grinder	Wilmarth & Marmon Co.
1		Chaser grinder	Landis Mach. Co.
1	2-in.	Bolt cutter	Landis Mach. Co.
1	2½-in. to 6-in.	Hand pipe threading machine	Oster Mfg. Co.

No.	Size and capacity	Type of machine	Builder or dealer
2	20-in.	Brass lathes	Dreses Mach. Tool Co.
1	20-in.	Brass lathe	Bardons & Oliver
2	48-in.	Radial drill presses	Carlton Machine Tool Co.
2	5-ft.	Radial drill presses	Fosdick Mach. Tool Co.
1	24-in. 2-spindle	Drill press	Fosdick Mach. Tool Co.
2	36-in.	Drill presses	Aurora Tool Works
1	36-in.	Crank planer	Newton Mach. Tool Co.
1	38-in. by 38-in. by 16-ft.	Planer	G. A. Gray Co.
1	60-in. by 60-in. by 16-ft.	Planer	Liberty Mach. Tool Co.
1	32-in.	Shaper	Ohio Mach. Tool Co.
2	32-in.	Shapers	Cincinnati Shaper Co.
1	36-in.	Draw cut shaper	Morton Manufacturing Co.
1	15-in.	Slotter	T. C. Dill Mach. Co.
1	18-in.	Slotter	T. C. Dill Mach. Co.
1	14-ft, 4-in. by 50-in.	Horizontal boring machine	Niles-Bement-Pond Co.
1	15-ft., 2-in. by 35½-in.	Rod boring machine	Baker Brothers, Inc.
1		Precision boring machine	Lucas Machine Tool Co.
1	42-in.	Vertical boring machine	King Machine Co.
1	54-in.	Car wheel boring machine	Wm. Sellers & Co.
2	8-ft.	Vertical boring mills	Cincinnati Planer Co.
1	54-in.	Vertical milling machine	Ingersoll Milling Machine Co.
1		Key seat milling machine	Niles-Bement-Pond Co.
2	12-in. by 1½-in.	Double end floor grinders	Hisey-Wolf Mach. Co.
16	18-in. by 3-in.	Double end floor grinders	Hisey-Wolf Mach. Co.
1		Cutter and reamer grinder	Wilmarth & Morman Co.
1	36-in.	Cold saw cut-off machine	Racine Tool & Mach. Co.
1	2½-in.	Bolt threading machine	Acme Machine Tool Co.
2	¼-in. to 2-in.	Pipe threading machine	Oster Manufacturing Co.
1	1-in. to 4-in.	Pipe threading machine	Oster Manufacturing Co.
2	48-in., 600-ton	Car wheel presses	Niles-Bement-Pond Co.
1	108-in., 800-ton	Single end driving wheel press	Chambersburg Engineering Co.
2	50-ton	Power forcing presses	Lucas Machine Tool Co.
1	48-in.	Double end punch and shear	Chambersburg Engineering Co.
1	36-in.	Band saw	Oliver Machinery Co.
3	36-in.	Rip saws	Greenlee Bros. Co.
1	24-in.	Hand jointer	Sidney Mach. Tool Co.

Oregon Short Line

2	20-in. by 12-ft.	Engine lathes	Manning, Maxwell & Moore
1	18-in. by 10-ft.	Tool room lathe	Manning, Maxwell & Moore
1	32-in.	Heavy duty shaper	Manning, Maxwell & Moore
1	4½-in. by 6-ft.	Portable boring bar	Salt Lake Hardware Co.
1	⅝-in. by 7-in. by 72-in.	Universal spring boring machine	Jos. T. Ryerson & Son
1	3-in. by 3-in.	Tool grinding and shaping machine	Wm. Sellers & Co.
1	12-in.	Bench type motor grinder	The Galigher Machinery Co.
1	No. 100	Bradley cushioned helve hammer	F. C. Richmond Machinery Co.
1	12-in.	Horizontal punch and bender	Manning, Maxwell & Moore
1	No. 28	Buffalo slitting shear	Interstate Mach. & Supply Co.
1	No. 11	Buffalo special bar cutter	Interstate Mach. & Supply Co.
1	½-in. to 6-in.	Pipe and tube cutting off mach.	Jos. T. Ryerson & Son
1		Electric tube welder	Federal Machine & Welder Co.
1	¼-in. by 12-ft. 1-in.	Steel power bending brake	Manning, Maxwell & Moore
1		Universal saw bench	Oliver Mach. Co.
1		Variety saw bench	Oliver Mach. Co.

Oregon-Washington Railroad & Navigation Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	3-in. by 36-in.	Flat turret lathe	Jones & Lamson Mach. Co.
1	48-in.	Car wheel boring machine	Manning, Maxwell & Moore
1		Side milling head	Newton Mach. Tool Wks.
2		Bench universal woodworkers	J. D. Wallace & Co.

Panama Railroad

No.	Size and capacity	Type of machine	Dealer or maker
1		Punch and shear	New Doty Manufacturing Co.

Peoria & Pekin Union

No.	Size and capacity	Type of machine	Builder or dealer
1	16-in. by 6-ft.	Portable engine lathe	American Tool Works
1	42-in.	Vertical turret lathe	Marshall & Huschart Co.
1	36-in.	Draw cut shaper	Morton Manufacturing Co.
2		Floor grinders	J. G. Blount Co.
1	500-ton	Wheel press	Chambersburg Engineering Co.

Pennsylvania System

No.	Size and capacity	Type of machine	Builder or dealer
1		Double head axle lathe	
4		Engine lathes	
5		Turret lathes	

No.	Size and capacity	Type of machine	Builder or dealer
1	¼-in.	Pneumatic flanging machine	McCabe Mfg. Co.
3	No. 2	Post boring machine	J. A. Fay & Egan Co.
1	8-in.	Bench hand planing and jointing machine	J. A. Fay & Egan Co.
1	16-in.	Bench hand planing and jointing machine	J. A. Fay & Egan Co.
1	24-in. by 8-in.	Surface planer	J. A. Fay & Egan Co.
1	36-in.	Automatic cut-off saw	J. A. Fay & Egan Co.
4	36-in.	Band saws	J. A. Fay & Egan Co.
1	30-in.	Band saw	J. A. Fay & Egan Co.
1	27-in. by 8-in.	Rip saw	Greenlee Bros. & Co.
4	19-in. by 4¼-in.	Rip saws	J. A. Fay & Egan Co.

San Antonio & Aransas Pass

No.	Size and capacity	Type of machine	Builder or dealer
1	18-in.	Slotting machine	Newton Machine Tool Wks.

Southern

2	90-in.	Locomotive journal lathes	Niles-Bement-Pond Co.
1	Double head No. 3	Axle lathe	Niles-Bement-Pond Co.
1	Double head No. 2	Axle lathe	Niles-Bement-Pond Co.
1	16-in. by 9-ft.	Engine lathe	Lehmann Machine Co.
1	18-in. by 8-ft.	Engine lathe	American Tool Works
1	18-in. by 8-ft.	Engine lathe	Boye-Emmes Mach. Tool Co.
1	18-in. by 10-ft.	Engine lathe	Cincinnati Lathe & Toole Co.
1	18-in. by 14-ft.	Engine lathe	Cisco Machine Tool Co.
1	24-in. by 8-ft.	Engine lathe	Cisco Machine Tool Co.
1	24-in. by 8-ft.	Engine lathe	Lehmann Machine Co.
1	24-in. by 14-ft.	Engine lathe	Reed-Prentice Co.
1	24-in. by 15-ft.	Engine lathe	Reed-Prentice Co.
1	30-in. by 16-ft.	Engine lathe	Cincinnati Lathe & Tool Co.
2	36-in. by 16-ft.	Engine lathes	R. K. LeBlond Mach. Tool Co.
1	42-in. by 8-ft.	Engine lathe	Niles-Bement-Pond Co.
2	15-in. by 31-in.	Portable engine lathes	R. K. LeBlond Mach. Tool Co.
1	3¼ by 29-in.	Universal turret lathe	Warner & Swasey Co.
1	7½-in. by 26-in.	Turret lathe	International Machine Tool Co.
1	6¼-in. by 34-in.	Turret lathe	Gisholt Machine Co.
3	3-in. by 36-in.	Turret lathes	Jones & Lamson Machine Co.
1	90-in.	Driving wheel lathe	Niles-Bement-Pond Co.
2	26-in. to 52-in., No. 4	Car wheel lathes	Niles-Bement-Pond Co.
1	13-in.	Tool room lathe	Pratt & Whitney
1	16-in.	Tool room lathe	Pratt & Whitney
1	17-in.	Tool room lathe	R. K. LeBlond Mach. Tool Co.
2	18-in.	Universal monitor lathes	The Dreses Mach. Tool Co.
2	20-in.	Universal monitor lathes	The Dreses Mach. Tool Co.
4	48-in.	Radial drills	Reed-Prentice Co.
1	60-in.	Radial drill	Niles-Bement-Pond Co.
4	60-in.	Radial drills	Ridgeway Manufacturing Co.
3	72-in.	Radial drills	Niles-Bement-Pond Co.
1	72-in.	Radial drill	Ridgeway Manufacturing Co.
1	20-in.	Upright drill press	Rockford Machine Tool Co.
3	26-in.	Upright drill presses	W. G. & John Barnes Co.
1	28-in.	Upright drill press	Rockford Machine Tool Co.
1	14-in.	High speed sensitive drill press	Chas. G. Allen Co.
1	6-in. to 14-in., No. 513	Heavy drill press	Baker Brothers, Inc.
1	6-in.	Centering machine	Pratt & Whitney
2	36-in. by 36-in. by 10-ft.	Planers	Niles-Bement-Pond Co.
1	36-in. by 36-in. by 14-ft.	Planer	Niles-Bement-Pond Co.
1	42-in. by 42-in. by 12-ft.	Planer	Niles-Bement-Pond Co.
2	72-in. by 72-in. by 14-ft.	Planers	Niles-Bement-Pond Co.
1	1½-in. by 16-ft., No. 3	Plate planer	Hilles & Jones Co.
1	32-in.	Draw-cut shaper	Morton Manufacturing Co.
3	32-in.	Shapers	Columbia Machine Tool Co.
2	32-in.	Shapers	Gould & Eberhardt
1	32-in.	Shaper	Cincinnati Shaper Co.
3	36-in.	Draw-cut shapers	Morton Manufacturing Co.
2	24-in.	Slotters	Niles-Bement-Pond Co.
4	30-in.	Vertical boring mills	Gisholt Machine Co.
1	44-in.	Vertical boring mill	Niles-Bement-Pond Co.
2	53-in.	Vertical boring mills	Niles-Bement-Pond Co.
1	84-in.	Vertical boring mill	Niles-Bement-Pond Co.
1	9-in. to 12-in.	Driving box boring & facing mach.	Wm. Sellers & Co.
2	36-in. to 44-in.	Side head boring mills	Niles-Bement-Pond Co.
2	48-in.	Car wheel boring mills	Putnam Machine Works
1	36-in. by 10-ft.	Horizontal milling machine	Newton Machine Tool Co.
2	42-in. by 30-in. by 16-ft.	Horizontal milling machines	Ingersoll Milling Machine Co.
1	No. 2-M	Universal milling machine	Cincinnati Milling Mach. Co.
1	No. 4	Universal milling machine	Cincinnati Milling Mach. Co.
2	54-in. by 42-in.	Rotary type milling mach.	Ingersoll Milling Mach. Co.
1	42-in. by 12-in.	Keyseating and cottering mach.	Newton Machine Tool Works

Southern (Continued)

No.	Size and capacity	Type of machine	Builder or dealer
1	18-in. by 30-in. by 96-in.	Piston rod grinder	Norton Co.
4	No. 2	Int. radius and link grinders	Rockford Milling Machine Co.
1	84-in.	Heavy guide box grinder	Diamond Machine Co.
1	8-in. by 1-in.	Double end dry grinder	J. G. Blount Co.
2	16-in. by 2-in., No. 76	Floor grinders	Safety Emery Wheel Co.
2	24-in. by 3-in., No. 84	Wet tool grinders	Safety Emery Wheel Co.
1	No. 1	Univ. tool grinder and shaping mach.	Wm. Sellers & Co.
1		Chaser grinder	Geometric Tool Co.
1	3-in.	Twist drill grinder	Wm. Sellers & Co.
1	15-in. by 2-in., No. 2	Swing frame grinder	Springfield Manufacturing Co.
1	12-in.	Power cold saw	Espen-Lucas Co.
1	6-in. by 6-in.	High speed hack saw machine	Peerless Machine Co.
1	10-in.	Crank pin turning machine	Edwards Machine Works
3	Six spindle	Radial stay thread. & turn. mach.	The Harrington Co.
7	2-in.	Double head bolt cutters	Acme Machinery Co.
1	⅜-in. to 4-in., No. 304-B	Pipe threading machine	Oster Manufacturing Co.
1	1½-in., 4-spindle	Nut tapper	Acme Machinery Co.
1	⅜-in. to 2-in.	Nut facing machine	Victor Tool Co.
1	400-ton, 54-in.	Car wheel press	Chambersburg Engineering Co.
1	600-ton	Driving wheel press	Southworth Foundry & Mach. Co.
1	800-ton	Driving wheel press	R. D. Wood & Co.
5	100-ton	Hydraulic bushing presses	Niles-Bement-Pond Co.
1	800-lb.	Single frame steam hammer	Niles-Bement-Pond Co.
2	1,500-lb.	Single frame steam hammers	Niles-Bement-Pond Co.
1	2,500-lb.	Single frame steam hammer	Niles-Bement-Pond Co.
2	3,400-lb.	Single frame steam hammers	Niles-Bement-Pond Co.
5	500-lb.	Helve hammers	C. C. Bradley & Sons
2	12-in. by 63 in., No. 26	Bulldosers	Williams, White & Co.
1	1¼-in.	Bolt heading machine	Williams, White & Co.
1	1½-in.	Bolt heading & forging mach.	Williams, White & Co.
1	3½-in.	Forging machine	Ajax Manufacturing Co.
1	48-in. by 1½-in. by 1-in. EF	Single end punching mach.	Cleveland Punch & Shear Co.
2	48-in. by 1½-in. by 1¼-in., G	Single end punching mach.	Cleveland Punch & Shear Co.
2	48-in., 1½-in. by 1¼-in.	Single end punching machines	Cleveland Punch & Shear Co.
1	48-in. by 1½-in. by 1 in., EF	Single end shear	Cleveland Punch & Shear Co.
2	48-in., 1½-in. by 1¼ in., G	Single end shearing machines	Cleveland Punch & Shear Co.
2	18-in., 2-in. by 1½-in.	Combined punch & shears	New Doty Manufacturing Co.
1	6-in.	Single end angle shears and punch	Buffalo Forge Co.
1	⅜-in. by 60-in., No. 37	Plate shear with punch attach.	Williams, White & Co.
2	2¼-in.	Flue welders	Thomson Spot Welder Co.
1	2½-in.	Flue welder	Thomson Spot Welder Co.
1	5½-in.	Flue welder	Draper Manufacturing Co.
1		Pit type flue cleaner	Jos. T. Ryerson & Sons
1	¼-in.	Sheet flanging machine	McCabe Manufacturing Co.
1	3½-in.	Horizontal bending roll	Southwark Foundry & Mach. Co.
1	4-in. by 4-in. by ½-in., No. 1	Angle bending roll	Jos. T. Ryerson & Sons
1	No. 6	Jackson die sinking mach.	Walcott Lathe Co.
1	3-in. by 16-in., No. 378B	Five spindle car boring mach.	J. A. Fay & Egan Co.
1	1-in. by 10-in., No. 284	Vertical mortiser	Wysong & Miles Co.
2	18 in. by 18 in.—½-in. to 3-in.	Vertical mortisers	J. A. Fay & Egan Co.
1	36-in. by 7-in., No. 156	Single cyl. surfacer	J. A. Fay & Egan Co.
2	15-in. by 6-in., No. 474	Planer and matchers	J. A. Fay & Egan Co.
1	16-in. by 20-in., No. 342	Vertical car sill tenoner	J. A. Fay & Egan Co.
1	7-in. by 3¾-in.	Combination saw and dado mach.	J. A. Fay & Egan Co.
2	18-in. by 11-in., No. 364	Automatic cutoff saws	J. A. Fay & Egan Co.
2	21-in. by 13-in., No. 3	Self feed rip saws	J. A. Fay & Egan Co.
2	22-in. by 7½-in., No. 4	Band scroll & resawing mach.	J. A. Fay & Egan Co.
1	36-in. by 42-in., No. 500	Variety saw	J. A. Fay & Egan Co.
1	36-in.	Wood cutting band saw	J. A. Fay & Egan Co.
1	12-in., No. 515-A	Universal woodworker	J. A. Fay & Egan Co.
1	42-in. by 8-ft. 6-in.	Door and blind clamp	Newman Machine Co.
2	24-in. by 20-in., No. 331	Car gaining machines	J. A. Fay & Egan Co.
1	2⅜-in., 2-spindle	Friezer and shaper	J. A. Fay & Egan Co.
1	42-in. by 6-in., No. 493	Single drum sandpapering mach.	J. A. Fay & Egan Co.
1	42-in. by 6-in., No. 399	Double drum sandpapering mach.	J. A. Fay & Egan Co.
1	4-in. sq., No. 326	Sash sticker and moulder	J. A. Fay & Egan Co.
1	12-in. by 6-in.	Heavy 4-side molder	Newman Machine Co.
2	24-in. by 14-in., No. 290	Timber dressers	J. A. Fay & Egan Co.

Spokane, Portland & Seattle

1	30-in. by 20-ft.	Engine lathe	Lodge & Shipley Mach. Tool Co.
1	3-in. by 36-in. by 15-in.	Turret lathe with auto. die	Jones & Lamson Mach. Co.
1		Universal milling machine	Kearney-Trecker Corp.
1	2-in.	Double head bolt threader	Landis Mach. Co.

Sugar Land

1	20-in.	Engine lathe	Jos. T. Ryerson & Son
1	20-in.	Drill press	Mechanics Tool Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	28-in.	Drill press	Mechanics Tool Co.
1		Crank shaper	Rockford Tool Co.
1	36-in.	Band saw	
1	6-in. by 6-in.	Hack saw	Wm. Robertson & Co.
1		Threading machine	Greenfield Tap & Die Corp.

Toronto, Hamilton & Buffalo

No.	Size and capacity	Type of machine	Builder or dealer
1		Axle lathe	J. Bertram & Sons
1		Grinder	Ransom Mfg. Co.
1		Flue rattler	Hamilton Engineering Service.

Union Pacific

No.	Size and capacity	Type of machine	Builder or dealer
1	45-in.	Journal and axle lathe	Niles-Bement-Pond Co.
1		Double axle lathe	Niles-Bement-Pond Co.
2	18-in. by 10-ft.	Engine lathes	Manning, Maxwell & Moore
1	18-in. by 12-ft.	Engine lathe	Manning, Maxwell & Moore
1	20-in. by 12-ft.	Engine lathe	Manning, Maxwell & Moore
1	36-in. by 16-ft.	Engine lathe	Manning, Maxwell & Moore
1	42-in. by 18-ft.	Heavy duty engine lathe	Niles-Bement-Pond Co.
1	4-ft.	Morris radial drill	Niles-Bement-Pond Co.
1	36-in.	Sliding head drill press	Niles-Bement-Pond Co.
1	22-in.	Vertical drill presses	Manning, Maxwell & Moore
1	36-in. by 36-in. by 14-ft.	Planer	Niles-Bement-Pond Co.
2	32-in.	Heavy duty shapers	Manning, Maxwell & Moore
1	28-in.	Heavy duty shaper	Manning, Maxwell & Moore
1	18-in.	Crank slotter	Hendrie & Bolthoff Mfg. & Sup. Co.
1	48-in.	Car wheel boring machine	Manning, Maxwell & Moore
1	100-in.	Vertical boring and turning mill	Consolidated Mach. Tool Corp.
1	48-in.	Putnam car wheel borer	Manning, Maxwell & Moore
1	Type J.	Car wheel grinding machine	Hendrie & Bolthoff Mfg. & Sup. Co.
1	4-spindle	Internal grinding machine	Manning, Maxwell & Moore
1		Double end emery grinders	Manning, Maxwell & Moore
1	4½-in. by 8-ft.	Portable cyl. boring bar	E. C. Cummings Co.
1	10-in.	Centering machine	Niles-Bement-Pond Co.
1	2-in.	Triple bolt threader and tapper	Niles-Bement-Pond Co.
1	2½-in.	Double bolt cutter	Niles-Bement-Pond Co.
1		National die sharpener	Manning, Maxwell & Moore
1	600-ton	Hydraulic wheel press	Manning, Maxwell & Moore
1	No. 3½	Cabinet mortising machine	J. A. Fay & Egan Co.
1	6-in. by 24-in.	Cabinet tenoner	Greenlee Bros. & Co.
2	6-in.	Bench jointers	J. D. Wallace & Co.

Union Refrigerator Transit Co.

No.	Size and capacity	Type of machine	Builder or dealer
1		Vertical car borer	Greenlee Bros. & Co.

Wabash

No.	Size and capacity	Type of machine	Builder or dealer
2	18-in.	Engine lathes	Colcord-Wright Machy. & Sup. Co.
1	24-in.	Engine lathe	Colcord-Wright Machy. & Sup. Co.
1	20-in.	Brass turret lathe	Colcord-Wright Machy. & Sup. Co.
1	15-in. by 6-ft.	Bolt lathe	Niles-Bement-Pond Co.
1	6-ft.	Radial drill	Niles-Bement-Pond Co.
2	⅞-in.—12-in. reach	High speed drill presses	Blackman-Hill-McKee Mach. Co.
1		Vertical drill press	Niles-Bement-Pond Co.
1	8-in.	Drilling and centering machine	Blackman-Hill-McKee Mach. Co.
1	32-in.	Shaper	Elliott & Stephens Mach. Co.
1	36-in.	Draw cut shaper	Morton Mfg. Co.
1		Milling machine	Blackman-Hill-McKee Mach. Co.
2		Automatic hack saws	Armstrong-Blum Mfg. Co.
1		Pipe machine	Manning, Maxwell & Moore
1	100-ton	Hydraulic forcing press	Manning, Maxwell & Moore
1		Punch and shear	Blackman-Hill-McKee Mach. Co.
1	4½-in.	Bar shear	Blackman-Hill-McKee Mach. Co.
1	¾-in.	Flanging machine	McCabe Mfg. Co.

Western Pacific

No.	Size and capacity	Type of machine	Builder or dealer
1	4¼-in. by 8-in. to 6-in. by 11-in.	Portable journal truing mach.	W. C. Dunn Co.
2	3-in. by 20-in.	Single end wet grinders	Blount Mach. Co.
1	3-in. by 18-in.	Double end dry grinder	Jos. T. Ryerson & Son
1	75-ton	Hydraulic press	Chambersburg Engineering Co.

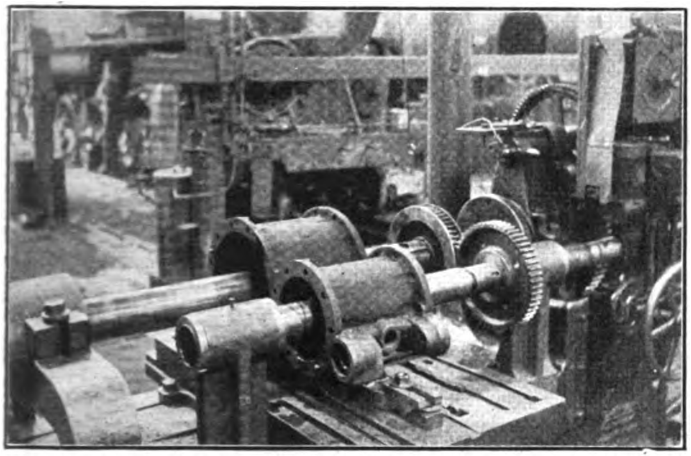
Wheeling & Lake Erie

No.	Size and capacity	Type of machine	Builder or dealer
2	18-in. by 8-ft.	Engine lathes	Cincinnati Lathe & Tool Co.
1	24-in.	Drill press	Aurora Tool Works
1	26-in.	Drill press	Aurora Tool Works

Boring bar for compound pump cylinders

By E. A. Murray
Shop Superintendent, Chesapeake & Ohio, Huntington, W. Va.

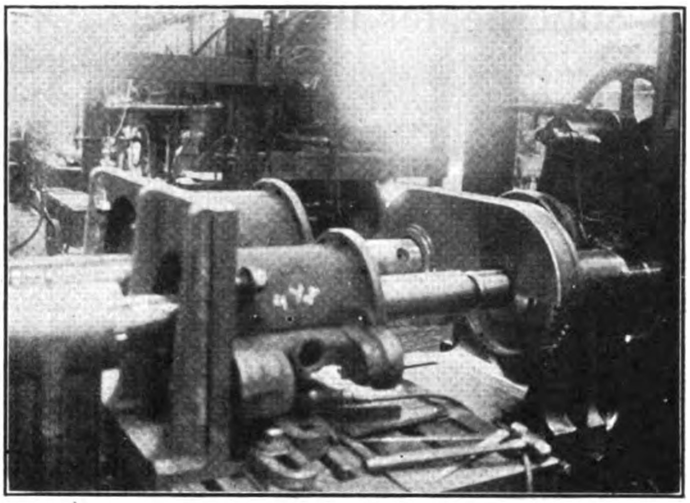
MANY original devices have been developed from time to time in railroad repair shops for reboring the cylinders of cross-compound air pumps. The majority of these boring bars, however, are designed to bore only one



General arrangement of boring bars with gear cover and angle bracket removed

of the two cylinders at a time. The drawing and illustrations to this article show the details as well as the operation of a boring bar which has been designed for handling this work in the Huntington shops of the Chesapeake & Ohio, and it differs from many others in that it performs the operation of boring both cylinders at one time.

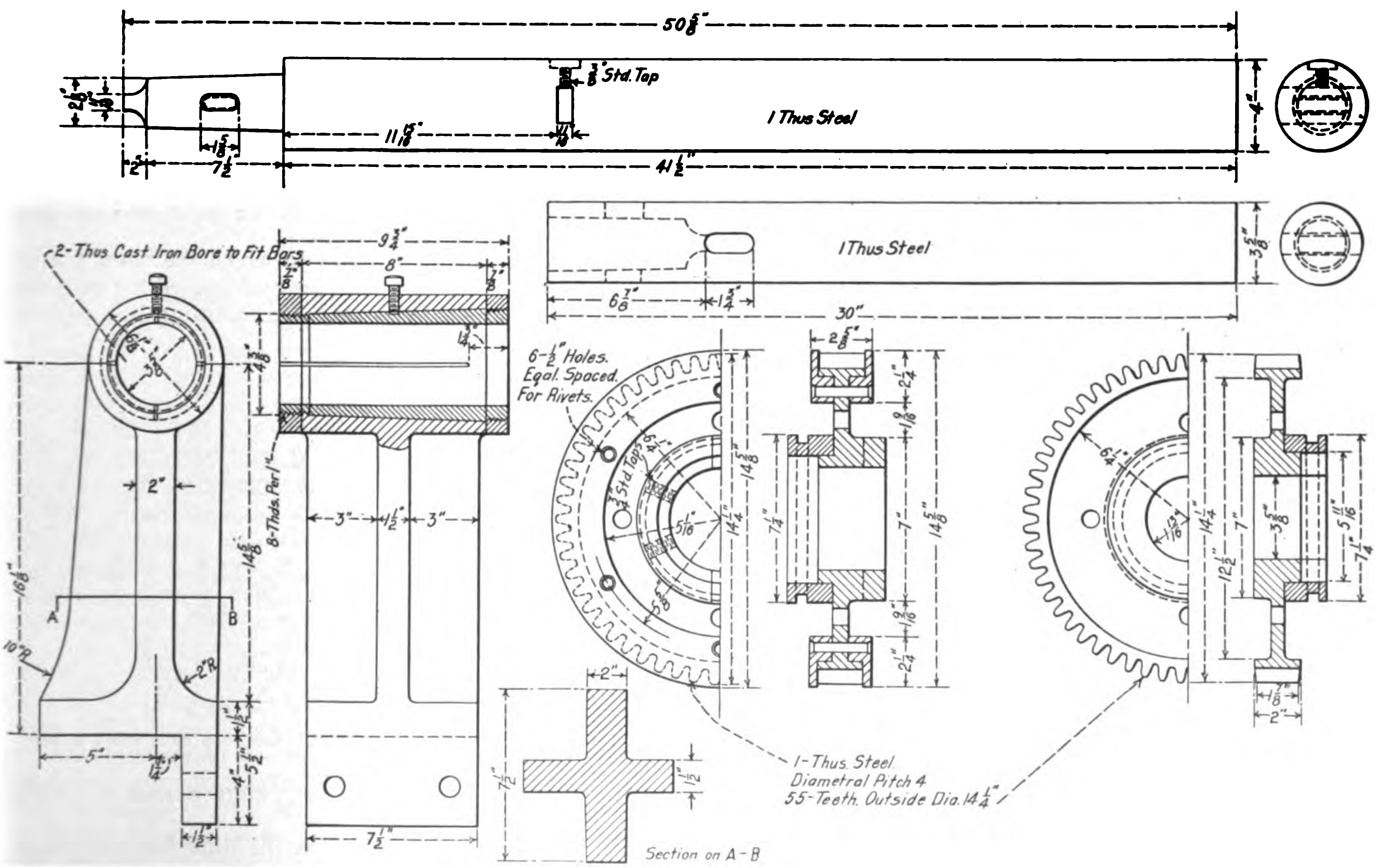
The device as a whole is simple to construct and to apply. It is intended for application to a horizontal boring mill, and consists of two parallel boring bars, one of which is



The cylinder casting is bolted to an angle bracket on the machine bed

driven from the spindle of the boring mill and the other, in turn, is driven by a flanged gear on the main bar which meshes with a gear on the auxiliary bar. Both bars are suitably supported by bearing brackets fastened to the table of the machine. The function of the flanged gear is to transmit to the auxiliary bar both the revolving motion for making the cut and the horizontal motion for the feed.

In actual practice the air pump cylinders are bolted to an



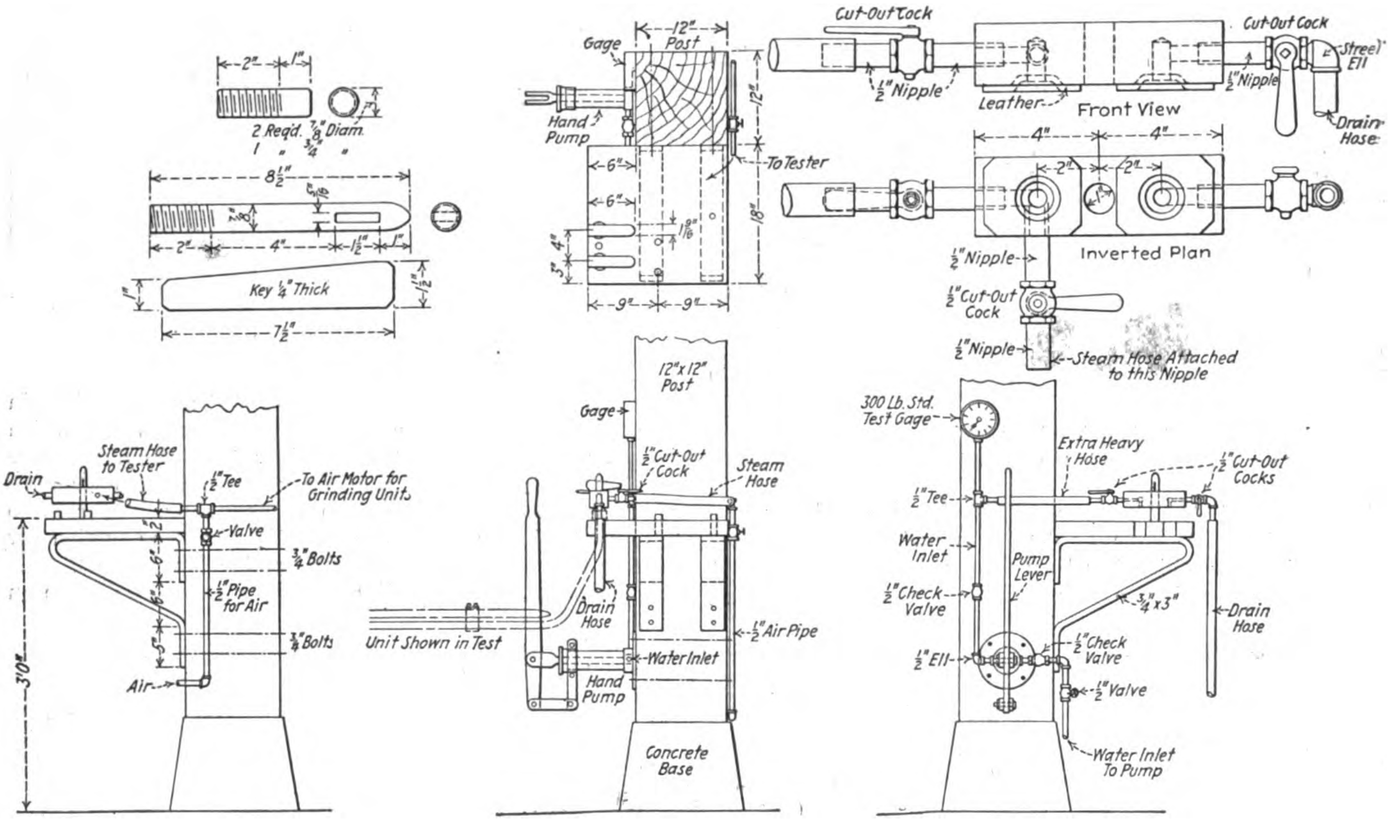
Details of construction of boring bars, gears and bracket

angle plate on the machine bed after which the bars are lined up to bore both cylinders at one operation. It has been found possible to reduce the time required on this job by about 50 per cent by the use of this device.

Superheater unit test rack

IN the drawing accompanying this article is shown a remarkably simple yet efficient device developed for testing superheater units. It was designed and constructed at the Minneapolis shops of the Chicago, Milwaukee and St. Paul.

As shown in the drawing, the rack rests on a bar iron bracket which can be fastened to a convenient column in the shop. On the bracket is a block with two slots for the unit pipes. This block, or table plate, is stationary and a ⅞-in. bolt with key slot is screwed into it. The superheater unit is inserted in the slots in the table plate, the cap is slipped down over the key bolt on to the ball joints of the unit and a tapered key is driven into the slotted bolt with a slight hammer blow which forces the cap down on the joints. Pressure is applied by means of a small hand pump conveniently located for the operator to handle. Valves and cut-out cocks are so arranged that the units may be filled with water and pressure pumped up for hydrostatic test and when the test is completed the water and scale can be blown out into a drain.



Constructional details of test rack for superheater units

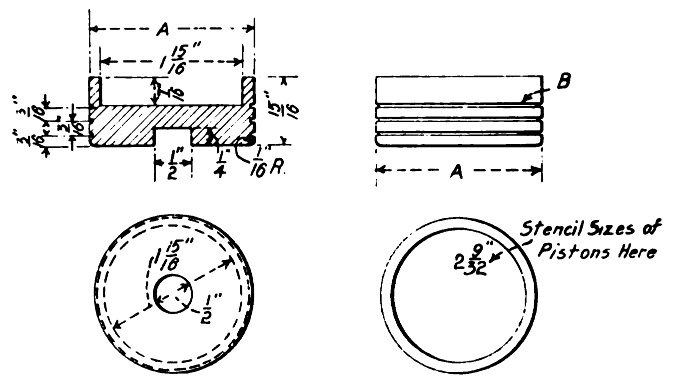
THE LOCOMOTIVES inspected by the Bureau of Locomotive Inspection in November numbered 5,143, of which 2,366, or 46 per cent, were found defective and 283 were ordered out of service, according to the Interstate Commerce Commission's monthly report to the Senate on the condition of railway equipment. Of 98,723 freight cars inspected by the Bureau of Safety 3,582 were found defective and of 1,773 passenger cars 15 were found defective. During the month 38 cases, involving 253 violations of the safety appliance acts, were transmitted to various United States attorneys for prosecution.

Reducing valve piston repairs

By Frank Bentley

A GREATER part of the efficiency of the steam heat reducing valve depends on the main valve piston. If properly repaired when required, it will be kept off of the engineman's report slip as well as off the repair bench.

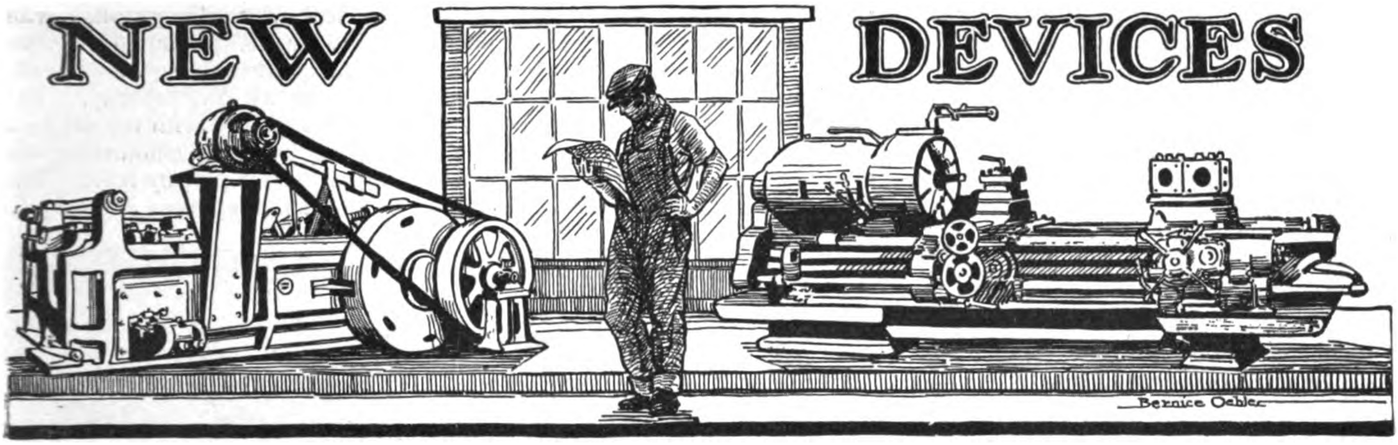
In order to prepare for the winter months a number of odd size stock pistons are made up early in the fall. The sizes in 1/32 in. are stenciled on the piston in the hollow portion of the top. The valve body is, of course, held on a mandrel as the cylinder is trued up. A piston of the proper diameter is selected for the size to which the worn portion is bored out. The removed pistons can be used for cylinders which true up to smaller sizes. By following this practice



Method of maintaining pistons for Leslie steam heat valves

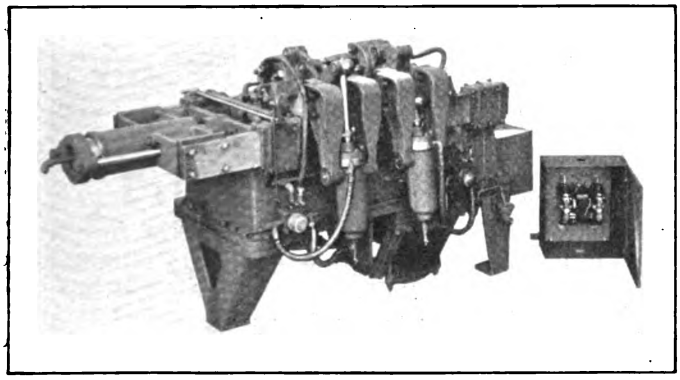
a small stock of pistons will keep quite a number of the reducing valves in working order.

When making up stock pistons the dimension *A* should be made up in sizes of 2 9/32 in., 2 5/16 in., 2 11/32 in., and 2⅜ in. The grooves *B* should be 1/32 in. square.



Electric butt welder with a water-cooled transformer

THE three accompanying illustrations show the No. 92 electric butt welder manufactured by the Federal Machine & Welder Company, Warren, Ohio. The machine is supplied with a remote control, magnetically operated switch, so designed that the metal

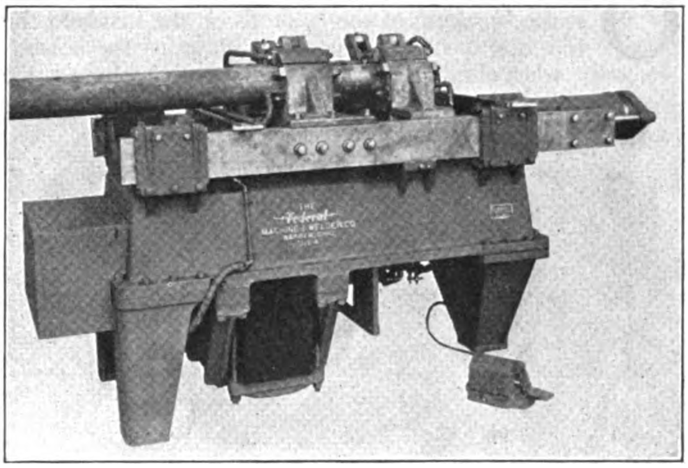


Rear view showing air cylinders and remote control switch in steel box

contacts are readily removed and replaced with slight expense. The switch has asbestos-wood flash plates, to prevent the arc from blowing out from the contacts when the circuit is open under heavy load and is also supplied with magnetic blow-outs, which extinguishes the arc. The switch is mounted on a heavy slate base, which is installed in a steel box, having a door arranged for locking to avoid tampering with the switch. A small shunt switch is supplied as part of the regular equipment. This is mounted directly on the operating lever, or at a convenient point on the welding machine.

The machine is supplied with a cylinder of the proper dimensions to give pressure capacity at the welding jaws of 3,000 lb. per sq. in. up to the given capacity of the machine, or the cylinder will have a capacity to apply 13,400 lb. pressure at the welding jaws, when supplied with 1,800 lb. pressure on the hydraulic line.

The transformer consists of heavy cast copper secondaries entirely surrounding the core and insulated from it with bakelite strips. Each section of these secondaries is supplied with a water cooling pipe which extends through its entire length. The secondaries are divided into three sections which are placed between four primary coils. The primary coils are wound with copper ribbon, the turns of which are insulated from each other with oiled muslin and asbestos ribbon. The coils complete are covered throughout with asbestos tape to make them fire and water proof. The insulation between the primary and secondary coils consists of a flexible material made up of asbestos fibre 1/8 in. thick, which has a break-down test of 20,000 volts. The entire set of transformer coils is mounted on the transformer core which is machined in sections, and the coils can be readily removed, in case it is desirable to dismantle the transformer. The core is made of high silicon, non-ageing transformer steel, having a low core loss. The entire equipment is air cooled. If the welders are equipped with a 100 k.v.a.



Welding a locomotive superheater tube in a Federal butt welder

capacity transformer it will have sufficient capacity to weld continuously 4½ sq. in. of metal.

The transformer is mounted under the movable main platen or slide in such a manner that it is impossible for dirt, flash or refuse coming from the weld to get in the windings of the transformer. It has been found that with the transformer located directly underneath the gap between the movable slides, the flash or throw-up from the weld falls directly on it and the strong magnetic pull induced by the secondary under the flow of the immense amperage has a tendency to pull the metallic dust into

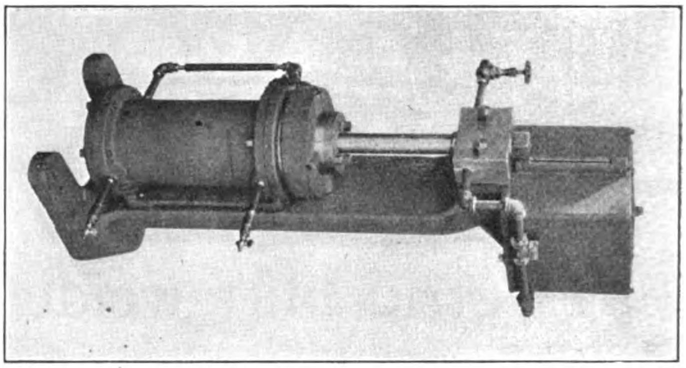
the windings, finally resulting in burn-outs or short circuits. It is claimed that this difficulty has been entirely eliminated in this machine as the transformer is not located under the slides and is further protected by a heavy slate slab, which extends directly from the under slide of the platen down nearly to the floor. The only parts of the electrical secondary that are exposed to the throw-off from the weld, are three heavy copper secondary connections, which extend to the left hand stationary electrode.

The welding machine has a three point bearing, that is, two legs on one end and one on the other. The four legged construction, unless very carefully installed, throws a twist in the machine, resulting in a binding of the slides and unsatisfactory work due to improper alinement.

The main movable platen or slide is carried on two heavy steel bars which extend the full length of the machine, giving a bearing between the sliding contacts of approximately 5 ft. 6 in. and at the same time placing the main bearings at the extreme ends of the machine where they are entirely out of the way of dirt and flash which is thrown off at the weld.

The transformer being supported directly under the movable slide and not enclosed in an oil-cooled case, is readily inspected and accessible for blowing out of whatever dirt may accumulate after long use. The main bearings which are of heavy steel construction are located at the outer ends of the machine and are easy to adjust and are arranged for proper lubrication by means of the Alemite system. An Alemite grease gun to lubricate all of the moving parts is supplied with the welder.

The machine is constructed with dies of the circular pattern design, held in position by wedge shaped clamps. The dies are located in holders which are supplied with water-cooling pipes. The water is permitted to flow through these holders at all times when doing heavy work, or handling the machine up to its full capacity. The pressure in clamping the pipe is applied with the aid of a toggle lever and air operating cylinder, eliminating the labor necessary in clamping large size pipe by hand. The actual pressure applied when clamping tubes is approximately 16 tons on each clamp. The circular shape of the dies provides proper alinement at all times.



Hydraulic intensifier used with the butt welder

The construction of the machine is such that the disposition of the frame to buckle is a remote possibility. The operating cylinder is so installed that a straight pull is applied to the moving platen and this, with the aid of the long bearing, eliminates the tendency to spring the bed plate.

Universal truck column anchor

One frequent source of trouble with arch bar trucks is the breaking of the columns on the inside at the top, due to repeated hammer blows of the bolster. Moreover, when the brakes are hung from the columns, the ears or support brackets are not infrequently worn through by the hanger pins or broken off.

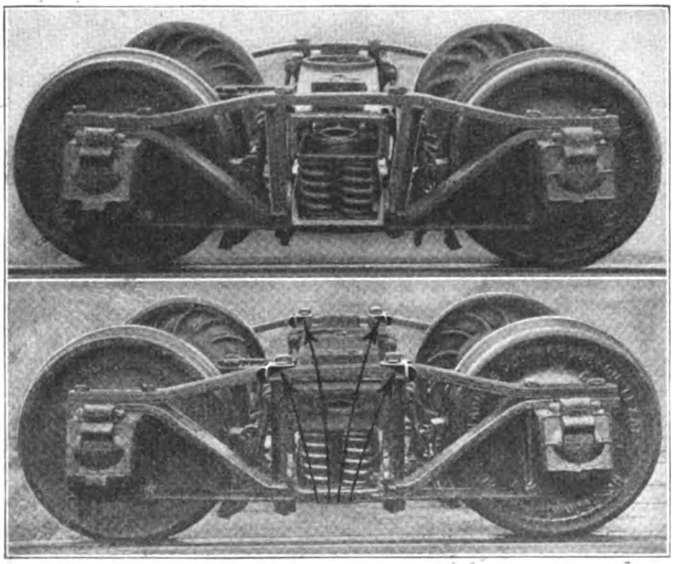


Fig. 1—Arch bar truck with broken columns (above); Same truck with broken columns held in place by Universal truck column anchors (below)

The cost of renewing truck columns when broken is considerable, depending on the weight and material from which they are made. Their period of usefulness is said to be greatly extended by the application of Universal truck column anchors, developed recently by the Universal Draft Gear Attachment Company, Chicago. By the use of these anchors the truck columns are supported at the top from the outer face and even if broken out on the inner face they are still serviceable. In fact, the defective columns, when supported at the top with these anchors, are said to be stronger than new columns without the anchors. In cases where the brake hanger bracket has been broken off, the truck column anchor is provided with an integral brake hanger support, thus making a permanent repair and retaining the old column.

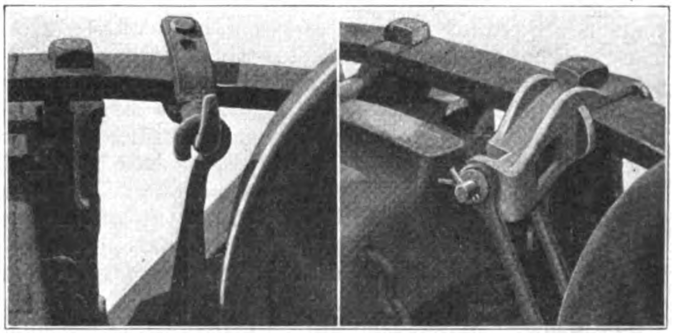


Fig. 2—Temporary repairs in case of broken brake hanger bracket (left) and permanent repairs (right) by means of Universal truck column with integral brake hanger bracket

In the upper part of Fig. 1 an arch bar truck is illustrated with all four columns broken out on the inner face as described. The same truck, fitted with Universal truck column anchors, by means of which necessary repairs are made and the old columns retained, is shown in the lower half of the illustration.

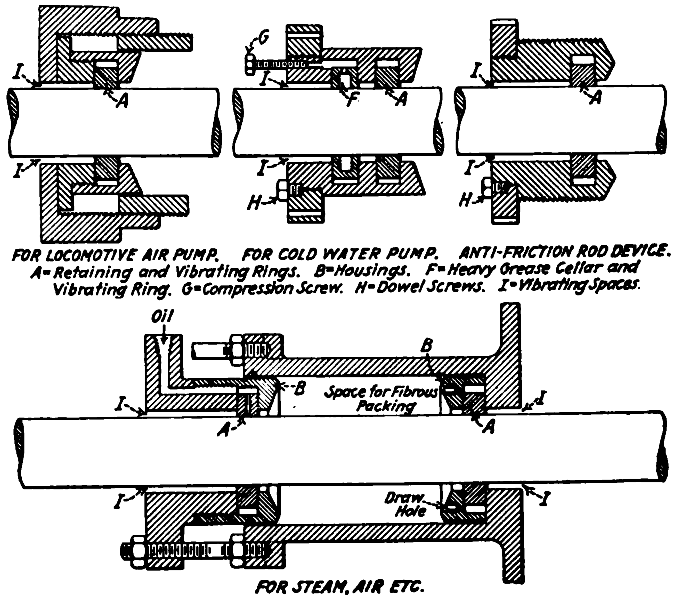
A truck with temporary repairs in case of a broken brake hanger bracket is illustrated at the left in Fig. 2, and at the right, the method of making permanent repairs by means of a Universal truck column anchor with integral brake hanger bracket which provides a permanent rigid support for the brake beam.

Packing gland provides for improper alinement

THE two main sources of packing troubles are improper alinement of machinery and improper adjustment of the compression gland by the operator. Few operators use calipers in making adjustments. Where calipers are not used, the operator invariably puts more tension on one adjustment nut than on the other, which results in a scored rod and cut packing. In trying to overcome this condition, the workman will apply more pressure in the gland. Unnecessary pressure is applied to the rod and more power is required to operate the machinery and, with this condition, the packing must be frequently renewed and eventually the scored rod must be removed or turned which undoubtedly increases the cost of packing gland maintenance.

In an effort to overcome these conditions William S. Sudekum, Nashville, Tenn., has developed and patented a packing gland to take care with an anti-friction rod device of improper alinement. Referring to the illustration showing the application of the device to steam, air and other glands, it will be noticed that the fibrous packing is cut at an angle of 45 deg. The object is to obtain a perfect fit with the least possible compression. The glands are bored no less than ¼ in. larger than the piston rod to prevent them from coming in contact with the rod.

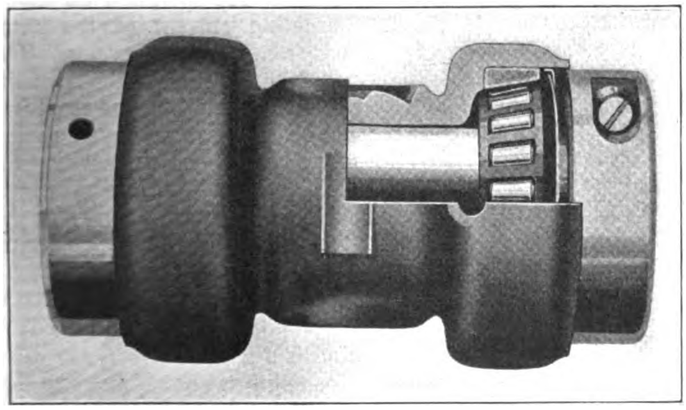
The retaining or vibrating rings are turned ¼ in. smaller than the bore in the housing in order that the rings may have the same amount of vibrating space as the rod. The packing is lubricated through the feed oil cup which is said to be economical as the vibrating rings will distribute the oil on the rod properly and without waste.



A method of packing piston rods which overcomes improper alinement of machinery and adjustment of the compression gland

Roller bearing for line shaft hangers

THE Dodge Manufacturing Corporation, Mishawaka, Ind., has placed on the market a line shaft bearing embodying the Timken tapered roller bearing, as well as several new features of construction.



Line shaft hanger bearing equipped with Timken tapered roller bearings

The special requirements that must be met by any appliance used in power transmitting service, such as ruggedness, simplicity, interchangeability and reliable lubrication, have been given the most careful consideration in the design and manufacture of this bearing. It consists of only five parts; two Timken tapered roller bearings mounted on a ground and slotted steel tube and fitted to an accurately machined housing. The ends of the steel tube are threaded to receive clamping collars designed to secure accurate adjustment of the bearings on the tube. This adjustment is made at the factory and need not be altered by the user.

The mounting of the tapered roller bearings, as described, insures full utilization of the bearings for both radial and thrust loads. It also adds to the ruggedness of the assembly and is of particular value in resisting the side weave of heavy driving belts. The method of fastening the steel tube or sleeve to the shaft permits its use on any commercial shafting. This fastening is accomplished by simply setting up the screws in each of the two clamping collars.

The sleeve on which the bearings are mounted extends from end to end of the housing. Liberal grease compartments are provided inside of the housing and outside of the tube. The outer ends of the bearings are protected against dust by special metallic grease seals which eliminate friction at this point and prevent dust working in or

the lubricant from working out. These grease seals take the place of felt washers or packing.

The erection of this lineshaft bearing is very simple. It is only necessary to slip the bearing over the shaft and set up the clamping screw in each of the split clamping collars. To remove it, in order to make any necessary repairs, the screws in the collars are loosened and the bearing slipped off the shaft.

Quartering gage with vernier attachment

PAGE 1407 of the June 11 issue of the Daily Railway Age contains a description of the improved quartering gage manufactured by The Ashton Valve Company, Boston, Mass. Since then the instrument has been further improved by the addition of a vernier attachment and an outside revolving casing. The gage can be used for testing crank pins for quartering in any position of the drivers without removing them from the frames; for checking the quartering of crank pins before setting the eccentric or crank arms of the valve motion; and it can be used to advantage when applying new axle to old wheel centers.

Each space upon the dial indicates one degree. Each space upon the vernier scale is six minutes or .1 degree shorter than one space on the dial scale. Thus, when the line marked zero on the vernier scale coincides with the line marked zero on the dial scale, the instrument is standing horizontally. When the dial is moved so that the graduation or line on the vernier scale next to the zero line coincides with the graduation next to the zero graduation on the dial scale, the included angle of the center line of the instrument and the horizontal center line has changed .1 degree or six minutes. To read the setting of the instrument, read directly from the dial scale, the number of whole degrees between the zero line, and the zero line of the vernier scale. Then count in the same direction, the number of graduations from the zero of the vernier scale to a graduation that coincides with a graduation on the dial scale; multiplying this number by six gives the number of minutes to be added to the number of whole degrees.

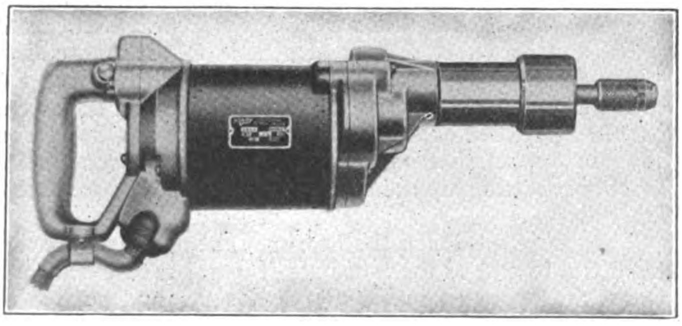
A table on the casing of each gage gives the linear variation corresponding to one degree of angular variation for the different strokes from 18 in. to 32 in. Provision has been made for suspending the gage from the crank pin by the use of a coil spring or strap.

Ashton locomotive driving wheel quartering gage provided with a revolving casing and vernier scale

Electric friction head screw driver

AN electric screw driver, the driving head of which is equipped with a disc type friction clutch, which is regulated automatically by pressure applied by the operator, has been placed on the market by the Hisey-Wolf Machine Company, Cincinnati, Ohio.

It is equipped with ball bearings throughout and designed with the company's universal motor for operation on direct current, or single phase alternating current of the same voltage, and for any frequency from 25 to 60 cycles. The quick-cable external connector is a feature which permits cable repairs and renewals without dismantling the machine. The switch is fitted to the handle grip. The clutch casing is of convenient size and serves as an end grip when the work requires. The screw slot finding attachment, which may be secured with the machine, is intended to prevent the driving bit from slipping out of the screw slot and marring the surface of the work. These are made in three sizes with bits 5/16 in., 3/8 in. and 7/16 in. diameter. Two screw driving bits are furnished with the machine.



Friction head screw driver fitted with a slot finding attachment

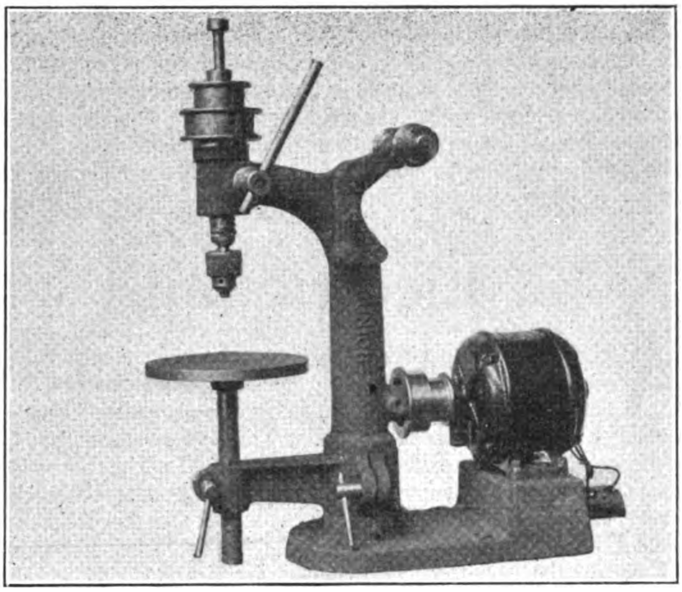
The capacity of the machine is for driving screws up to No. 14, 2½ in. long, in soft or solid wood. When suitable lead holes are provided, larger wood and lag screws up to 5/16 in. in diameter by 4 in. in length can be driven. These machines can also be used for setting up nuts to 3/8 in. in metal and wood. They are 15½ in. long and 3¾ in. in outside diameter. The no load speed of the spindle is 525 r.p.m. The net weight is 9½ lb.

Motor driven bench drill

When the Buffalo Forge Company, Buffalo, N. Y., first put its Junior 10 in. bench drill on the market it was driven by a motor through a pinion and gear which resulted in a noisy operation. In order to overcome this defect, the machine has been redesigned with a ¼-hp., 1,750 r.p.m. motor with the belt drive pulleys keyed to the motor shaft. This gives a quiet, positive power transmission and also saves space. The spindle runs in a large bronze bushing, and is provided with a No. 2-A Jacobs chuck. Two speeds are provided and the shifting from one speed to the other is accomplished without using tools as the idler works with a snap socket.

The machine has a substantial cast iron frame and a finished circular table movable in both horizontal and vertical positions. The normal driving speed is 550 r.p.m., although it can be driven as high as 3,000 r.p.m. and still remain in balance.

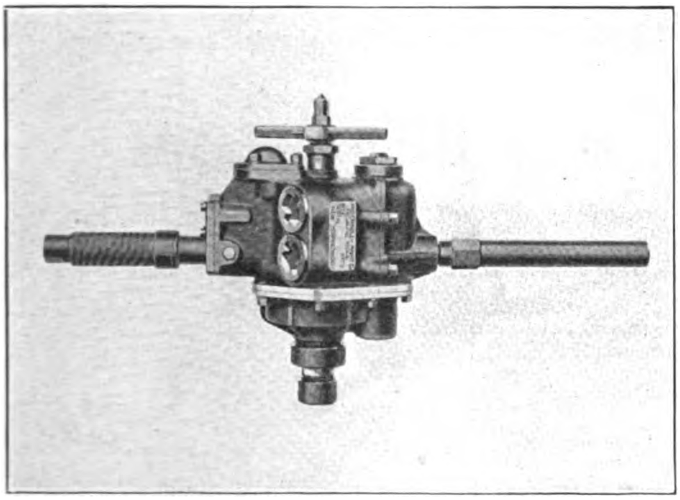
The height of the drill is 27½ in. with an 8-in. diameter table. It can drill holes up to ⅜ in. and to the center of a 10-in. circle. The travel of the spindle is 8½ in. and the greatest distance from the table to the spindle is 8 in. It also has a vertical movement of 3½ in. The net weight is 66 lb.



Buffalo Forge 10-in. Junior bench drill

Pneumatic drill provided with a speed governor

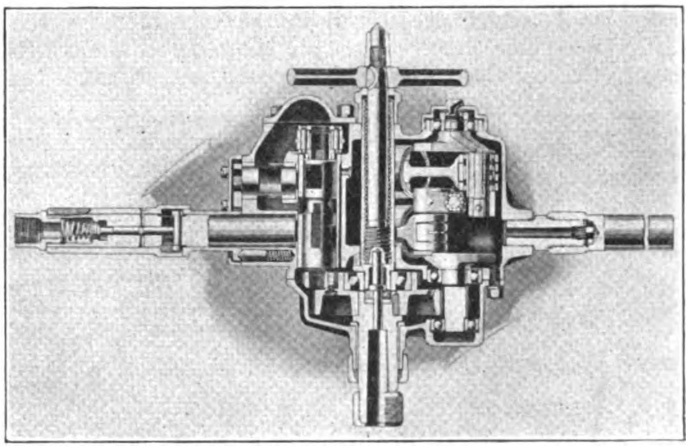
The Ingersoll-Rand Company, New York, has recently added to its list of pneumatic tools a four cylinder pneumatic drill equipped with a speed governor to eliminate the racing of the machines when running free. This governor is set so that the machine will do the maximum amount of work at the proper working speed. In addition to the governor, the valve mechanism consists of one valve of a gear timed construction. This valve is balanced at all times and there is, therefore, practically no wear on the valve or on the valve bushing.



Ingersoll-Rand reversible pneumatic drill

All the cylinders have special steel liners, fitted into the steel casing, which are easily removed and renewed. With this construction, it is said to be practically impossible to dent the cylinder liner as the wall of the casing on the outside protects it, there being a chamber between the casing wall and the cylinder proper.

The crank pins are fitted with sleeves which are held stationary so that all of the wear takes place on the sleeve instead of the crank pin. Therefore, if a crank pin bearing becomes worn, instead of renewing the entire crank shaft, it is only necessary to renew the one sleeve. The crank pin bearings are lubricated from the inside of the crank pin out, instead of by revolving in a grease-filled crank case. It has been found that the centrifugal force of a high speed crank shaft throws the grease away to such an extent that the crank pin usually receives very little lubrication. With this method, the centrifugal force aids lubrication by throwing the grease from the inner part of the crank shaft out through the crank pin bearings.



Sectional view of pneumatic drill equipped with a speed governor

A helical type of gearing is used for the crank pinion and the main driving gear. With this type of gearing, there are always two teeth engaged instead of only one as with the spur gear type. This considerably reduces the tooth pressure on the gears. The crank pinion is also

renewable. A new method of venting the casing through the crank shaft is used, which gives a better venting for the casing and still will not throw out the grease which is used to lubricate the machine.

The dead handle is screwed onto a stud which is set into the crank cap of the drill. This eliminates the wear which occurs when a dead handle is screwed directly into the crank cap proper as it is necessary to take out the dead handle frequently in order to properly lubricate the drill. The drill is fitted with a new type reversible throttle which has a rotating reverse throttle in addition to a poppet throttle. This is said to give excellent service and eliminate leaking. The throttle is fitted with a spring center with notches for the full forward speed, full reverse and dead center and is very easily regulated by the operator.

The crank parts can be completely assembled outside of the drill case and then inserted in the case. This feature saves time and assembling and assures the work being properly done. It avoids lost time from working on small parts if the crank has to be assembled in the case.

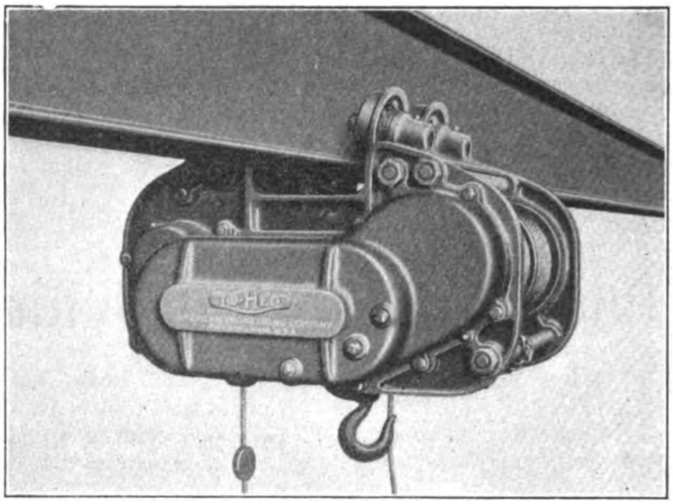
Electric hoist with low headroom

An electric monorail hoist designed to operate in a minimum headroom has been placed on the market, in half-ton and one-ton sizes, by the American Engineering Company, Philadelphia, Pa. This hoist retains many of the features that distinguish the other "Lo-Hed" hoists made by the same company, but is smaller and is intended for general utility use where a light, handy electric hoist is needed.

Like all the "Lo-Hed" line, this hoist is able to draw the load hook up until it almost touches the rail, which makes it available for use in places where, because of low headroom, no other hoist could be used. It gives additional clearance and safety for bulky loads and makes it possible to pile materials higher than could be done by any other means, thus increasing the capacity of storage spaces by utilizing the space almost up to the ceiling.

Automatic holding and lowering brakes are provided and a safety device checks the hoist at the upper limit of travel and throws off the current. High duty roller bearings and automatic lubrication give a high efficiency. A factor of safety of five makes overloads possible in emergency.

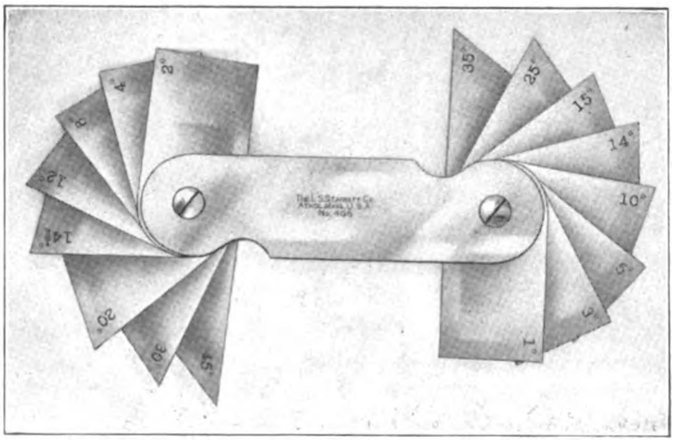
These hoists are furnished for either direct or alternating current. All working parts are completely accessible and the motor can be removed for repairs in a few minutes without touching the load on the hook.



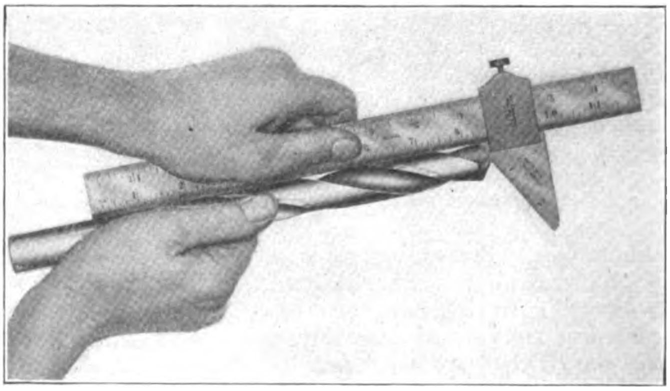
A view of the Lo-Hed Hoist showing gear and drum

Hand tools adaptable to railway shops

The accompanying illustrations show four hand tools which are useful in the tool room or the machine shop. The angle gage contains 16 leaves, the ends of which are ground on an angle to most frequently used, including 14½ deg., one-half the Acme Standard. The gage is about 9/32 in. thick, 11/16 in. wide and 4-3/16 in. long. It includes angles from 1



Angle gage No. 466 includes angles from 1 to 45 deg.

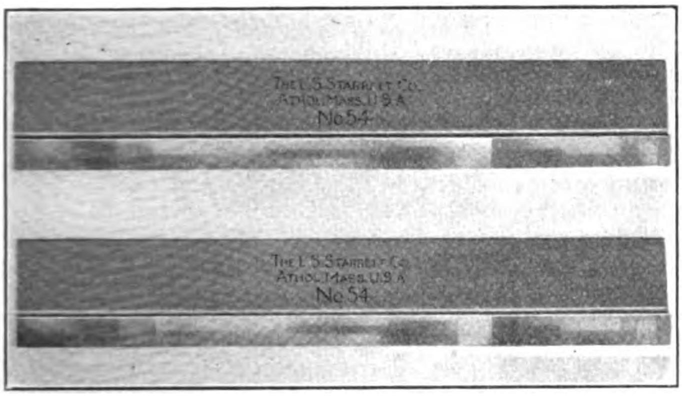


Drill point gage No. 22 designed for assisting in grinding drill points accurately.

degrees. The leaves are made from spring tempered steel and their two sides, as well as the angle edge, are ground. The gage embodies a combination of angles to 45 deg. It is especially useful to inspectors and toolmakers.

The drill point gage has been designed for the specific purpose of assisting in grinding drill points accurately.

The method proposed for sharpening the cutting edges is to do one at a time. For satisfactory results, each lip must not only be the same length, but must also have the same angle in relation to the axis of the drill. Experience has determined that for ordinary drilling purposes a 59-deg. angle has advantages. When the lips or cutting



Tool steel, hardened and ground hold-downs

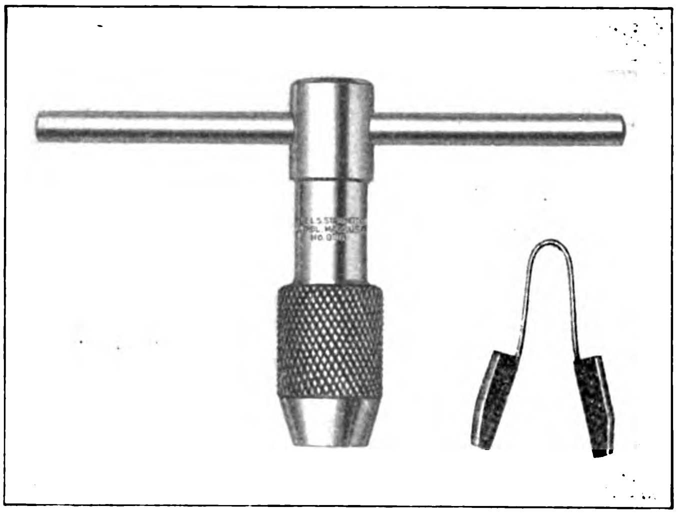
edges are the same, then it follows that the "dead center" will be located on the drill axis.

The use of this gage should effectively eliminate not only the breaking away of the cutting edges, splitting the drills and drilling oversize holes, but also break-downs from straining the machine bearings.

The blade furnished has sixty-fourth and thirty-second graduations on one side and sixteenths and eighths on the other. The angle part lies in the plane of the blade and, being adjustable, may be clamped to any point in its length. It may be also used as a square, depth gage, or book rule. The blade is 12 in. long.

The hold downs are used to hold work down flat as on a machine platen or in a vise where a small amount is removed from a surface, and where other methods of clamping are inconvenient. Work can be securely held without distortion. The contact edges are slightly tapered so as to force the base of the work to the bed of the machine. They are made of tool steel, hardened and ground.

The T-handle tap wrench is used for holding taps to be turned with the hand, and is also useful for holding drills, reamers and other small tools. The body is centered, enabling the workman to start the tap straight when using it on lathe centers or in an upright drilling machine. Its unique construction permits the jaws to conform to the



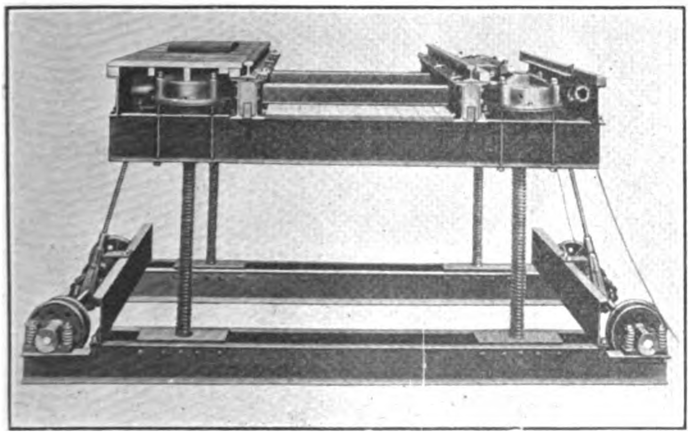
A T-handle tap wrench known as tool No. 93

piece to be held, making it rigid and less apt to become loose. The jaws and the knurled clamping nuts are heat-treated to withstand any ordinary use.

These tools are manufactured by the L. S. Starrett Company, Athol, Mass.

Whiting screw-type electric drop table

The Whiting Corporation, Chicago, has developed a new screw-type electric drop table which may be designed to perform any dropping operation on wheels or other parts of locomotives or cars. Particular



Whiting self-contained electric drop table for enginehouses

advantages in the design of this drop table are safety, secured by the worm and gear type drive now used on over 100 Whiting hoists; ample, reliable power by means of electric motor drive; the absence of air or water lines, a feature of importance particularly in the northern states; and the provision in a single unit of a drop table for driving wheels and tender truck wheels.

The new drop table consists essentially of a truck with four stationary screws, the table being built on top. Wheels and axles are provided at each end of the truck, being inserted in roller bearings to permit easy lateral movement. The boxes are spring supported so that when the full locomotive weight is received, the springs will deflect. This in turn seats the screws on the rails, passing the weight directly onto the foundation of the pit track.

The table rails are reinforced and supported by beams. The load is carried to the driving units by means of transverse channels. The driving units consist of worms and worm wheels with roller thrust bearings. The latter are 14 in. in diameter and contain 56 rollers. The driving motor is mounted on the table, thus making it safe from flood. The control is a matter of choice but the push button type with extension cord gives the most flexibility.

The pit is rectangular in cross section and may be constructed straight or in conformity with the enginehouse circle. Channels are set in the wall to guide the table and insure its being correctly positioned. Sockets are pro-

vided for the power plug, from which a flexible cable leads to the hoisting motor.

In operation the power is turned on and the table run up until the locomotive weight is relieved from the locking bars. These bars are thrown out, a single lever performing the operation, and the table and load are then dropped to the low position. The entire unit is moved laterally by ratchets, the use of roller bearings making it possible to do this with one hand.

In dropping locomotive drivers, it is not necessary to take the locomotive weight on jacks before starting, as the new table has a capacity of 50 tons. Neither is it necessary to spot the locomotive closely as the entire rail section drops. As there are no heavy rail beams to be moved out of the way, one mechanic and a helper can do the work. In replacing the drivers with a drop pit, they are first lifted into position, the rail beams moved in place and a scaffold erected. With the drop table, the operator can stand in the table pit and come up with the drivers. The shoes can be placed first and held by shims. The pedestal binders can be set on blocks and fitted with wedges. In this way all the operations can be performed at once, saving time.

If the table is of sufficient length, two pairs of drivers or tender truck wheels can be dropped in a single operation. On the other hand, a single pair of tender wheels can be removed by just running them out on the table and blocking under the spring seat. Trailers may be handled, or a cradle casting can be blocked on the table and dropped without using extra blocks and tackle.

Boosters are readily removed on the drop table, a difficult operation on a drop-pit jack because of the shifting weight. This is due to the overhanging weight of the booster engine and the spring weight, which drops to zero after a few inches. The Whiting drop table has four legs and any shift of weight does not affect it. In addition, spring work is said to be done quickly and easily without disturbing any box packing. To renew a spring the table is raised two inches above the rail and the spring rigging blocked. The table is then dropped, taking the weight off the spring. It can then be readily removed. The same method can be employed in spring equalization.

Truck or trailer brasses also can be replaced readily. After blocking the box, the table can be dropped a few inches. On account of the self-locking worm drive, it is then safe to remove and replace a brass.

A self-contained centrifugal oil-extractor

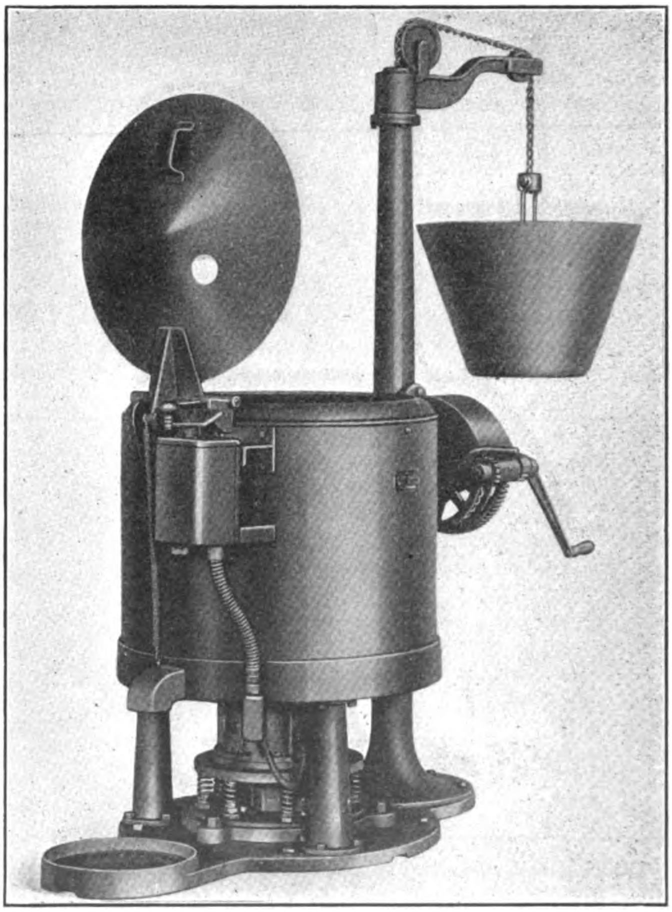
AN entirely self-contained centrifugal oil-extractor electrically driven, eliminating belt, countershaft or motor stand, quarter turn pulleys, mechanical brake and rubber bumpers has recently been designed by the Curtis Machine Company, Worcester, Mass., and is being sold by the Crescent Washing Machine Company, New Rochelle, N. Y.

The motor is equipped with Timken bearings. The bearing at the lower end of the motor carries the radial loads only, while the upper bearing carries the radial loads and also the thrust load of the pan assembly, the spindle and the chip load. The weight of the entire assembly comprising the motor and pan is carried by a pivot bearing in the base of the machine. By means of a unique compensating feature in the application of the motor unit all vibration, common to this type of machinery, is transferred direct to the base of the machine.

The motor is of the squirrel cage type, specially designed to meet the requirements of this type of machine. It can be run on 220-volt, 440-volt or 550-volt, 60 cycle, three phase a.c. current. It has a speed of 1,165 r.p.m. and is mounted directly upon the spindle of the machine. The motor is controlled by a drum type controller conveniently mounted on the drum of the machine. The running or forward position is positive while the reverse side is spring actuated and is arranged for braking. The machine may be accelerated under full load in 10 seconds and stopped in 12 seconds.

An automatic safety lock is applied to the cover hinge. This device prevents the operation of the machine except when the cover is in the closed position, and at the same time prevents the splashing of oil.

The pan is filled with machine chips, or other material from which the oil is to be extracted, and then placed in position on the spindle by means of the hoist. The pan cover is then secured in place by means of the spindle nut and the machine run for from three to five minutes at a speed of 1,200 r.p.m. The resulting force acting upon the load is the equivalent of about 350 times gravity. The chips, being confined to the pan, are thus separated from the oil which leaves through various small openings between the pan and the cover and then finds its way to the spout in the base of the machine. For efficient handling the chips should first be gravity drained and an extra pan provided so that one may be loaded while the other is extracting.



An entirely self-contained oil extractor for removing oil from machine cuttings

General News

Locomotive and train cost statistics dispensed with

The Interstate Commerce Commission has amended its order relating to the compilation of monthly operating statistics, to annul the requirement of the reports of locomotive and train costs, selected accounts, except as to the reports to complete the twelve months of 1924.

Simultaneous application of M. C. B. couplers to all rolling stock in Japan

On some day in June, 1925, yet to be determined, the standard M. C. B. automatic coupler will be placed in service simultaneously on all the rolling stock of the Imperial Japanese Government Railways, replacing the manual type with side buffers now in use.

Wage statistics for September

The total number of employees reported by Class I railroads for the month of September, 1924, was 1,801,296, a decrease of 144,621, or 7.4 per cent as compared with the number reported for the same month of 1923, according to the Interstate Commerce Commission's monthly bulletin of wage statistics. The total compensation decreased $14,557,938 or 5.7 per cent. A comparison of the returns for the months of August and September, 1924, shows that in September the employment increased 0.7 per cent and the total compensation increased 0.5 per cent.

A. F. of L. condemns enginemen's brotherhood

The action of the chairman of the Brotherhood of Locomotive Engineers, in refusing to pay the union scale of wages in the brotherhood's mines in West Virginia and in replacing union miners with non-union workers, was condemned by the American Federation of Labor in resolutions adopted at the annual convention at El Paso, Tex., on November 22. The committee on resolutions reported to the convention that it had found there had been a strike in effect in four mines of the company in West Virginia since April 1, due to the failure of the company to renew a wage agreement; that the officers of the United Mine Workers of America had made repeated efforts to reach an agreement with the Brotherhood; that the miners and their families have been evicted from company houses and strike breakers have been employed.

In commenting on the adoption of the resolution, John L. Lewis, president of the Miners' Union, declared that "the refusal of the Coal River Collieries to deal with the United Mine Workers has been a scandal in the entire organized labor movement."

The convention also denounced the United States Railroad Labor Board and endorsed the Howell-Barkley railroad labor bill now pending in Congress.

Southern Pacific enginemen vote for strike

Although 90 per cent of the engine service employees on the Southern Pacific have voted in favor of a strike, there is little likelihood of such action being taken, at least for some time. William Sproule, president of the Southern Pacific, has made arrangements with the Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen & Enginemen, representing the employees, to hold an early joint conference. The strike vote was taken as a result of the refusal of the management to renew direct negotiations with the brotherhoods on their request for general wage increases. The Southern Pacific was only one of the large number of western railways which participated in the dispute on the question before the Railroad Labor Board, but was picked out by the brotherhood executives as the road on which concerted efforts to secure acquiescence to their demands might best be made. The decision of the Labor Board which awarded a wage increase to the employees of 5 per cent on condition that they accept a number of changes in working rules apparently has not affected the situation on the Southern Pacific. Developments are being watched with great interest by the other roads involved in labor board decisions since the attitude of the brotherhoods toward the decision will be made known by the steps they take in the Southern Pacific case.

Higher wages will not necessitate higher rates

The Railroad Labor Board has denied the petition of the managers representing the Western Railways that the settlement made by the Southern Pacific with its enginemen and firemen be set aside. This petition averred that the proposed advance in wages would tend to necessitate general increases in freight rates. The board holds that there is no sufficient ground for this contention. The board considers only the increase on the Southern Pacific and compares only with that company's earnings. The board ignores the fact, presented by the managers, that the engine service brotherhoods had already gone to one other road with the demands that were made on the Southern Pacific; this as the first step in a campaign to have the Southern Pacific agreement apply generally to the western roads. The engine service brotherhoods were given until January 1 to agree to the provision of the Labor Board's decision in the case which ordered wage increases of six per cent, accompanied by changes in working rules which the brotherhoods violently opposed. There is no expectation among the western managements that this decision will receive any consideration whatever from the brotherhoods. If they ignore the decision, as is expected, the Board's finding provides that the same wage rates and working rules that have been in effect shall be continued.

A. R. A. to investigate power brakes

The American Railway Association has completed plans for a complete study and exhaustive investigation of power brakes and appliances for operating power brake systems. The investigation, the cost of which will be borne by the American Railway Association, will be conducted by Harley A. Johnson, assistant general manager of the Chicago Rapid Transit Railway, who, as director of research, will employ such assistants as may be necessary for conducting the work.

The American Railway Association, after conferences with the

LOCOMOTIVE REPAIR SITUATION

Date, 1924	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No. req. running repairs	Per cent	Total req. repairs	Per cent
February 1	64,377	53,586	4,116	5,919	9.2	4,872	7.6	10,791	16.8
March 1	64,431	53,127	3,800	6,047	9.4	5,257	8.1	11,304	17.5
April 1	64,363	52,805	4,648	6,128	9.5	5,430	8.4	11,558	17.9
May 1	64,330	52,890	6,079	6,105	9.5	5,335	8.3	11,440	17.8
June 1	64,373	53,498	6,661	6,099	9.5	4,776	7.4	10,875	16.9
July 1	64,416	53,382	7,117	6,035	9.4	4,999	7.7	11,034	17.1
August 1	64,486	53,381	7,152	6,073	9.4	5,032	7.8	11,105	17.2
September 1	64,582	53,618	6,762	6,023	9.3	4,941	7.7	10,964	17.0
October 1	64,538	53,209	5,424	6,175	9.6	5,154	8.0	11,329	17.6
November 1	64,486	53,391	4,776	6,191	9.6	4,904	7.6	11,095	17.2
December 1	64,406	52,832	4,904	6,128	9.5	5,446	8.5	11,574	18.0

Data from Car Service Division reports.

director of the Bureau of Safety of the Interstate Commerce Commission, has agreed on the following plan:

1. Steps will be taken to obtain appliances, which, it is claimed, meet the views of the Interstate Commerce Commission, as indicated in its preliminary report and conclusions. If the plans or specifications for such appliances are available and the appliances are not yet being manufactured, steps will be taken by the director of research to secure such appliances, even to the extent of entering into an agreement to have such appliances made.
2. As soon as such appliances have been obtained they will be given exhaustive tests on the test rack at Purdue University, Lafayette, Indiana, which rack will be completely prepared and brought up to date for the purpose of this investigation.
3. Following the completion of the rack tests such devices will be given road tests, to develop whether or not they meet road conditions safely in service.
4. This program will be carried out with all dispatch and as promptly as the devices for these tests are available.

The investigation will also embrace such further study as may in the judgment of the director of research throw further light upon this problem.

Court news

EMPLOYERS' LIABILITY.—The Kentucky Court of Appeals holds that neither a machinist in defendant's roundhouse, injured while engaged in setting valves on engines nor the railroad was engaged in either interstate or intrastate commerce, so that the state Employers' Liability Act, which only applies when railroad and injured person are "engaged in commerce," was not applicable.—Idol v. L. & N. (Ky.) 261 S. W. 878.

WRONGFULLY DISCHARGED EMPLOYEE MUST MINIMIZE DAMAGE BY TRYING TO OBTAIN OTHER EMPLOYMENT.—The Mississippi Supreme Court holds that a servant engaged for a specified time and wrongfully discharged must make reasonable exertion to prevent loss by obtaining other employment, and if he enhances his damages by wilfully or negligently remaining out of employment the increased loss must fall on him.—Batesville-Southwestern v. Vick (Miss.) 90 So. 7.

AGREEMENT REQUIRING SHIPPER TO INSPECT CARS HELD INVALID.—The Louisiana Supreme Court holds that a clause in a bill of lading requiring the shipper to inspect the carrier's own cars and assume the risk of defects therein is invalid because (1) it requires the shipper to assume a risk arising from the carrier's own negligence in failing to inspect; (2) shifts the burden of proof to the shipper, and (3) requires an unskilled person to make an inspection which only an expert can make.—Coustaline v. L. R. & N. (La.) 98 So. 81.

EVIDENCE OF DEFECTIVE COUPLER.—The Federal Safety Appliance Act makes the duty to maintain couplers in such condition that they will always couple automatically by impact absolute, and the Mississippi Supreme Court holds that where plaintiff's testimony showed that because of the use of a nail instead of a cotter pin in the drawhead, a coupling could not always be made by the ordinary use of the lift lever, the nail catching on a part of the drawhead, there was sufficient evidence of a defective coupling appliance and a violation of the act, though it was not shown that the injured employee attempted to use the lift lever.—Yazoo & M. V. v. Cockerham (Miss.) 99 So. 14.

Ask extension of time for train control

Petitions for a postponement of the effective date of the Interstate Commerce Commission's order of June 13, 1922, as modified by its order of July 18, 1924, requiring installations of automatic train control, have been filed with the commission by the Lehigh Valley, the Cincinnati, New Orleans & Texas Pacific and the Southern.

In the petition of the C. N. O. & T. P., and the Southern, it is stated that 35.5 miles between Ludlow and Williamstown, Ky., have been equipped with the auto-manual type of inductive train control and that the equipment is now ready for inspection by the commission, and that this has been asked for; and that, until this installation and its performance under actual operating conditions have been inspected and observed by the commission's representatives and a report made, the petitioners hesitate to go forward on a major scale with the work of equipping the remaining mileage required by the order. Therefore, further time is asked in which to comply with the mandate of the order, and it is stated that if the present installation is approved the roads will proceed as rapidly as possible to equip the remaining mileage as required by the order.

The Lehigh Valley petition asks for a postponement of the effective date for six months. It says that a contract has been made with the General Railway Signal Company for the installation of the auto-manual system between Easton, Pa., and Newark, N. J., and that the full roadside equipment has been installed between Phillipsburg and Flemington Junction, N. J., over 20 miles, while ten locomotives have been equipped. This, the petition says, constitutes a bona fide effort to secure and install a device that will comply with the commission's order, and warrants additional time to complete the work.

The Delaware & Hudson Company has petitioned the commission to be exempted from the order of June 13, 1922, contending that its financial condition does not warrant such expenditures when other improvements are needed. The company says it has made serious efforts to install the automatic train control, but that its experiments to date do not justify such an expenditure as the commission contemplates. Experiments have been made with many systems of automatic train control on three miles of road, but the device needs further development.

The railroad further says it has ordered all material for the installation of automatic train control, beginning at Rouses Point, N. Y., and extending southward for one division. It declares that this will be installed and tested as soon as possible.

Labor Board decisions

INTERPRETATION OF INTERMITTENT SERVICE RULE.—A decision on questions raised in regard to the meaning and intent of the Intermittent Service Rule of Decision No. 630 has been made by the Railroad Labor Board. The rule in question reads as follows: "Where service is intermittent, 8 hours actual time on duty within a spread of 12 hours shall constitute a day's work. Employees filling such positions shall be paid overtime for all time actually on duty or held for duty in excess of 8 hours from the time required to report for duty to the time of release within 12 consecutive hours, and also for all time in excess of 12 consecutive hours computed continuously from the time first required to report until final release. Time shall be counted as continuous service in all cases where the interval of release does not exceed one hour." In answering questions raised in regard to the rule, the Labor Board decides that the meal period provided for in other rules of the decision cannot be considered as a part of the period of release under the Intermittent Service Rule. The board also decides that a carrier is within its rights in applying Rule 49 to a position or positions without first reaching an agreement with the representatives of the employees as to whether the rule is applicable, the employees if they disagree with the management to take up the matter in accordance with the provisions of the Transportation Act. In interpreting the language of the rule reading:

FREIGHT CAR REPAIR SITUATION

1924	Number freight cars on line	Cars awaiting repairs			Per cent of cars awaiting repairs
		Heavy	Light	Total	
January 1	2,279,363	118,653	39,522	158,175	6.9
February 1	2,269,230	115,831	45,738	161,569	7.1
March 1	2,262,254	119,505	49,277	168,782	7.5
April 1	2,274,750	125,932	46,815	172,747	7.6
May 1	2,271,638	131,609	47,666	179,275	7.9
June 1	2,280,295	138,536	50,683	189,219	8.3
July 1	2,279,826	144,912	49,957	194,869	8.5
August 1	2,278,773	153,725	49,139	202,864	8.9
September 1	2,296,589	158,200	51,909	210,109	9.2
October 1	2,304,020	157,455	48,589	206,044	8.9
November 1	2,313,316	150,703	39,840	190,543	8.2
December 1	2,304,676	146,286	42,854	189,140	8.2

Month	Cars repaired		
	Heavy	Light	Total
December	87,758	2,073,280	2,161,038
January	76,704	2,083,583	2,160,287
February	70,056	2,134,781	2,204,837
March	77,365	2,213,158	2,290,523
April	75,352	2,074,629	2,149,981
May	73,646	2,130,284	2,203,930
June	70,480	1,888,899	1,959,379
July	72,347	1,567,430	1,639,777
August	71,863	1,420,482	1,492,345
September	74,295	1,372,277	1,446,572
October	87,008	1,446,822	1,533,830
November	75,954	1,304,924	1,380,878

"Intermittent service is understood to mean service of a character where during the hours of assignment there is no work to be performed for periods of more than one hour's duration and service of the employees cannot otherwise be utilized," the board rules that whether the carrier is the sole judge as to whether or not there is work to be performed and if the service of the employees can otherwise be utilized shall be determined by the actual conditions in every case. The board rules also that it is not permissible to place an employee under the provisions of this rule by assigning his work to other employees so as to make it possible to allow him the period of release prescribed by the rule. Finally, the board rules that it is not permissible to place an employee on an intermittent service assignment where it can be shown that there is work to be performed during the period of release, even though the work can just as well be accomplished in a 12-hr. spread. An opinion dissenting from the decision of the board on the last two questions was rendered by Messrs. Elliott, Baker and Higgins, board members representing the railways.—Interpretation No. 3 to Decision No. 630.

Meetings and conventions

Mechanical division meeting in 1925

At a meeting of the General Committee, Division V—Mechanical A. R. A., held in New York, December 11, it was decided that the annual meeting of the Division for 1925 be a strictly business meeting, and that it be held in Chicago during the week commencing June 15.

It was decided at the meeting that the attendance at the Chicago meeting be restricted to the members of the General Committee of Division V, members of the various committees of Division V, and the voting representatives of the railway members of Division V, American Railway Association.

Later in the day of September 11, the General Committee of Division V met the Executive Committee of the Railway Supply Manufacturers' Association and announced the decision. J. J. Tatum, chairman of Division V, emphasized the fact that inasmuch as no exhibit of railway supplies and machinery would be held in 1925, it was to be hoped that in the following year a mechanical convention would be held with a larger and better exhibit than ever and a large attendance of railway supply men.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next meeting May 5-8, Los Angeles, Cal.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V.—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago. Business meeting to be held in Chicago during week commencing June 15. No exhibit of railway supplies and machinery will be held.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMAN'S ASSOCIATION.—G. G. Macina, 11402 Calumet ave., Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth street, New York. Railroad Division, A. F. Steubing, Bradford Corp., 23 West Forty-third street, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt Street, New York, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill. Next annual convention May 26-29, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash St., Winona, Minn.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Next convention May 19-25, Hotel Sherman, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass. Next meeting January 13. Paper on the Preservation of Forest Products will be read by Herman Von Schrenk, consulting timber engineer, New York Central.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollmer, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Next meeting January 9. Paper on Railway Problems will be presented by Harvey Rubey, professor railway engineering, University of Missouri.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern railway shops, Atlanta, Ga. Next meeting January 13 and 14, Ansley Hotel, Atlanta, Ga.

TRAVELING ENGINEER'S ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September, 1925, Chicago.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 189 West Madison St., Chicago. Meetings third Monday in each month, except June, July and August. Annual meeting May 23, Edgewater Beach Hotel, Chicago.

LOCOMOTIVES ORDERED, INSTALLED AND RETIRED

Month 1924	Installed during month	Retired during month	Aggregate tractive effort	Owned at end of month	Aggregate tractive effort	Building in R. R. shops
January	271	178	4.447.721	64.989	2,552,694,953	14
February	214	175	4,906,435	65,029	2,559,519,253	10
March	176	181	6,033,173	64,911	2,560,076,766	7
April	97	112	2,881,385	64,896	2,561,362,769	11
May	153	107	2,600,445	64,942	2,565,706,413	10
June	160	178	4,575,358	64.924	2,569,121,875	72
July	197	113	3,354,456	65.008	2,576,433,377	63
August	229	166	5,346,176	65,062	2,583,372,980	50
September	160	151	4,351,378	65,071	2,586,083,994	37
October	113	220	5,712,633	64,964	2,586,106,026	76
November	181	263	7,749,794	64,882	2,586,826,278	70
Total for 11 months	1,951	...	....	......	....	..

Figures as to installations and retirements prepared by Car Service Division, A. R. A., published in Form C. S. 56A-1. Figures cover only those roads reporting to the Car Service Division. They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

FREIGHT CARS ORDERED, INSTALLED AND RETIRED

Month 1924	Installed during month	Aggregate capacity tons	Retired during month	Aggregate capacity tons	Owned at end of month	Aggregate capacity tons	Building in R. R. shops
January	15,589	707,367	12,329	516,695	2,310,032	100,644,107	2417
February	11,386	554,481	10,466	411.228	2,310,570	100,767,731	2715
March	9,962	446,043	8,726	352,481	2,311,495	101,165,332	2697
April	8,718	369,978	8,026	306,288	2,312,074	101,223,891	2739
May	9,199	439,516	9,059	360,212	2,312,237	101,303,200	2467
June	10,909	538,118	8,347	321,094	2,314,798	101,569,593	2269
July	16,583	1,151,302	8,413	316,927	2,322,968	102,388,652	4602
August	15,452	785,288	8,834	333,173	2,329,582	102,845,000	3618
September	15,455	779,078	9,337	370,607	2,335,147	103,270,000	3045
October	16,598	834,762	10,504	218,806	2,342,149	103,688,000	2506
November	.....						
Total for 11 months	129,451						

Figures as to installations and retirements prepared by Car Service Division A. R. A. Figures cover only those roads reporting to the Car Service Division. They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

Supply Trade Notes

The Link-Belt Company, Chicago, has moved its St. Louis office to 3638 Olive street.

B. B. Phillips has resigned as general manager of the Gifford-Wood Company, Hudson, N. Y.

M. T. Lothrop has been appointed vice-president of the Timken Roller Bearing Company, Canton, Ohio.

T. R. Talbot, manager of the St. Louis district of the Republic Iron & Steel Company, has resigned.

The Link-Belt Company, Chicago, has opened a warehouse and office at 5938 Linsdale avenue, Detroit, Mich.

The Pawling & Harnischfeger Company, Milwaukee, Wis., has changed its name to the Harnischfeger Corporation.

The Wine Railway Appliance Company, Toledo, Ohio, will construct a plant in that city to cost approximately $150,000.

The corporate name of the Zapon Leather Cloth Company, Wilmington, Del., has been changed to the Zapon Company.

The Mid-West Engineering Company, Chicago, has moved its sales office to the Steger building, 28 East Jackson boulevard.

Johns-Manville, Inc., will establish a plant in New Orleans, La., the first unit of which will be equipped and in operation by April.

Samuel Hale, formerly vice-president of the Interstate Iron & Steel Company, Chicago, died at Santa Fe, New Mex., on October 25.

Charles H. Bromly has been appointed manager of the lubrication and filtration division of S. F. Bowser & Co., Ft. Wayne, Ind.

C. J. Thompson, district sales manager of the Osgood Company, with headquarters at Chicago, has been transferred to New York.

The Joyce-Cridland Company, Dayton, Ohio, has opened an office in the Railway Exchange building, St. Louis, Mo., in charge of R. C. O'Brien.

The Chicago Varnish Works, Chicago, Ill., will in the future be operated under the name of E. I. du Pont de Nemours & Co.—Chicago Works.

The Cleveland Twist Drill Company, Cleveland, Ohio, plans the construction of one, two and four-story plant additions to its factory at Cleveland.

T. E. Beddoe has been appointed industrial sales engineer of the Cutler Hammer Manufacturing Company, with headquarters at Philadelphia, Pa.

J. B. Marks, purchasing agent of the Colorado Fuel & Iron Company, with headquarters at Denver, Colo., has also been appointed assistant to the president.

Benjamin P. Lane has been appointed local manager of the newly opened branch office and warehouse of the Sullivan Machinery Company at Los Angeles, Calif.

W. S. Campbell has been appointed manager of domestic machinery sales in the eastern district for Joseph T. Ryerson & Company, Inc., with headquarters at Jersey City, N. J.

J. F. Kroske has been appointed manager of pneumatic tool sales for the Ingersoll-Rand Company, in the Pittsburgh territory. Mr. Kroske's headquarters are at Pittsburgh, Pa.

The Linde Air Products Company has opened a branch office at Salt Lake City, Utah, in charge of R. L. Strobel and another office at Seattle, Wash., in charge of C. E. Rheim.

The Union Metal Products Company will expend $500,000 for the remodeling of its plant at Hammond, Ind., which it recently acquired from the Keith Railway Equipment Company.

D. E. Sawyer, formerly general sales manager of the Pollak Steel Company, New York, has been appointed vice-president of the Wanner Malleable Castings Company, Hammond, Ind.

Martin H. Schmid, metallurgical engineer of the United Alloy Steel Corporation, has been appointed assistant general manager of sales of the alloy division, with headquarters at Canton, Ohio.

P. Blair Lee, who has been engaged in special work for the vice-president and general manager of Birdsboro Steel Foundry & Machine Company, Birdsboro, Pa., has been appointed works manager.

The Southwark Foundry & Machine Company, Philadelphia, Pa., has discontinued its Cleveland office. This office is now located at 100 East South street, Akron, Ohio, in charge of F. H. Smith.

The Dallas office of the Franklin Railway Supply Company, under the supervision of S. D. Rosenfelt, district manager, have been moved to the Boatmen's Bank building, 314 North Broadway, St. Louis, Mo.

N. C. Failor Company, 30 Church street, New York, and G. A. Pabst, 106 South Jefferson street, Chicago, have been appointed direct sales representatives of the Stockbridge Machine Company in their respective territories.

C. S. Price, First National Bank building, Hazelton, Pa., has been appointed district representative for northeastern Pennsylvania of the Conveyors Corporation of America, Chicago. E. F. Elliott is associated with Mr. Price.

The Gibb Instrument Company, Bay City, Mich., has changed its name to the Gibb Welding Machine Company. The company is now engaged exclusively in the manufacture of electric welding and heating machines. There has been no change in organization.

Glen D. Evans, for many years connected with the J. F. Buhr Machine Tool Company, but more recently chief engineer of the Climax Engineering Company, at Los Angeles, Cal., has again joined the Buhr organization in the capacity of chief engineer.

T. R. Langan has been appointed manager, transportation division in the New York office of the Westinghouse Electric & Manufacturing Company to succeed A. J. Manson recently promoted to manager, heavy traction division of the railway sales department at East Pittsburgh, Pa.

The American Car & Foundry Company has sold to a Canadian syndicate its stockholdings in the Canadian Car & Foundry Company. It is understood that two or three Canadian men will replace the American Car & Foundry representatives who were elected to the directorate at the time of the stock purchase in 1920.

O. M. Bostwick, New York representative of the publicity department of the General Electric Company and formerly advertising manager of the Sprague Electric Works, has resigned. After a short vacation, it is expected that Mr. Bostwick will resume his activities in the technical publicity field in New York City.

The U. S. Metallic Packing Company, Philadelphia, Pa., has taken over the entire business of the Locomotive Lubricator Company, of Chicago, manufacturers of the Schlacks system of force feed lubrication. W. J. Schlacks, C. W. Rudolph and O. H. Neal, formerly of the Locomotive Lubricator Company, have become affiliated with the U. S. Metallic Packing Company.

The Milburn Sales Company, distributors in the Philadelphia territory for the Alexander Milburn Company, Baltimore, Md., makers of oxy-acetylene welding and cutting apparatus and portable carbide lights, has taken over the Metropolitan New York district with headquarters at 309 Fifth avenue. E. P. Boyer, D. Keyser and other assistants will be in charge of the New York City office.

E. A. Thornwell has been appointed representative of the Premier Staybolt Company, Pittsburgh, Pa., in the southeastern district, with headquarters in the Candler building, Atlanta, Ga., and E. B. Corbett has been appointed representative in the southwestern district, with headquarters at the corner of Sawyer and Winter streets, Houston, Tex. The company was previously without representation in these districts.

J. B. Odell, manager of the New York telephone distributing house of the Western Electric Company, New York, has been appointed assistant to the president of the company. Mr. Odell

has been in the service of the Western Electric Company since 1904. He served in 1909 as head of the equipment division of the telephone department at New York, and the following year became assistant manager. He later was manager at Richmond, Va., before becoming manager of the New York house.

The Hopp-Patterson Company has been organized under the laws of Illinois to engage in selling industrial equipment and supplies in Chicago. The organizers are J. H. Hopp, former vice-president of the Charles C. Kawin Company, and J. B. Patterson, district manager of the P. H. & F. M. Roots Company, Connersville, Ind. The equipment to be handled by the new company includes steam and centrifugal pumps, conveying and transmission equipment and air compressors.

A. A. Corey, Jr., president of the Vanadium Corporation of America, New York, announces that an arrangement has been made with the United States Ferro Alloys Corporation for the merging of that concern with the Vanadium company. The plan involves the acquisition of complete control of the operations and affairs of the Alloys company immediately, but the corporate organization will be maintained. Mr. Corey, president, and L. K. Diffenderfer, treasurer of the Vanadium Corporation have been elected also president and treasurer respectively of the United States Ferro Alloys Corporation.

A. H. Weston, sales engineer of the T. H. Symington Company, with headquarters at New York, has been elected vice-president in charge of sales of the Car Devices Company, with headquarters at Richmond, Va. Mr. Weston obtained his early mechanical training in the motive power department of the Baltimore & Ohio and the Western Maryland and was for several years mechanical engineer for the Atlantic Coast Line. He left railroad service to enter the employ of the T. H. Symington Company as mechanical engineer and for the past ten years has been sales engineer for the same company, with headquarters at New York.

Arthur J. Manson, manager of the transportation division, railway department, of the New York office of the Westinghouse Electrical & Manufacturing Company, has been appointed to the position of manager of the heavy traction division, railway department, at Pittsburgh, Pa., effective November 1. After graduating from the Massachusetts Institute of Technology in 1905, he entered the company's engineering apprentice course and assisted in the building and testing of the first electric locomotive for the New York, New Haven & Hartford. In the spring of 1907 he was assigned to the electrification work on this road and aided in the inauguration of the electric service. In this position he instructed the steam enginemen in their duties as electric enginemen. Mr. Manson was associated with the preliminary test conducted by the Pennsylvania Railroad on Long Island prior to the decision as to the system to be used in the Pennsylvania tunnels entering New York City. Later he became associated with F. H. Shepard, director of heavy traction, entering the New York office of the Westinghouse Company. He assisted Mr. Shepard in connection with the Pennsylvania contract for power house, substation and locomotives for the Pennsylvania New York tunnel electrification. In 1910 Mr. Manson entered the sales department of the New York office following construction, subway and elevated work. In 1920 he was made manager of the transportation division of the New York office which position he held at the time of his recent appointment. During the time when Mr. Manson was manager of the transportation division he wrote and published a book entitled Railway Electrification.

A. J. Manson

Trade Publications

Thermaload starters.—Bulletin No. 106, descriptive of the thermaload starter for small alternating current motors, has been issued by the Monitor Controller Company, Baltimore, Md. An alternating current contractor combined with a thermal relay are the essential parts of this starter.

Electric equipment for cranes.—A 35-page bulletin, No. 48732, descriptive of electric equipment for cranes, has been issued by the General Electric Company, Schenectady, N. Y. Particular reference to crane motors and control, brakes, etc., is made and information is given on operating characteristics.

Hammers.—The Blacker "B" hammers, designed especially for tool dressing and general utility jobbing work, are described in an 8-page illustrated brochure issued by the Blacker Engineering Company, Inc., New York. The hammer travels over the anvil face performing hand forging and smithing operations without helpers.

Arches.—A 50-page catalogue showing the adaptability of its arches to all types of boilers and stokers, industrial furnaces and oil stills, has been issued by the M. H. Detrick Company, Chicago, Ill. The application of the Detrick sectional supported wall to pulverized fuel furnaces is described for the first time in this catalogue.

Electric tools and shop equipment.—Drills, bench and pedestal grinders, tappers, screw drivers, socket wrenches, post and bench drill stands, etc., are among the electric tools and shop equipment illustrated and described in the attractive 32-page catalogue, No. 8, recently issued by the Black & Decker Manufacturing Company, Towson, Md.

Bolt heading machine.—The Ajax Manufacturing Company, Cleveland, Ohio, has just issued bulletin No. 50, which is well illustrated and tells the complete story of the new heavy duty continuous motion heading machines for making bolts and rivets. This new machine contains some important improvements which should interest those who have anything to do with machinery of this type.

Turret lathes.—The No. 4 Universal turret lathe, which permits independent operation of two tool carrying units, the cross slide carriage and the hexagon turret slide and saddle, is fully described in a 12-page illustrated brochure issued by the Warner & Swasey Company, Cleveland, Ohio. Quick change of set-up from one job to another is provided and measuring, due to positive stops, is eliminated.

Exhaust steam injectors.—A 23-page illustrated booklet giving description and instructions for the installation and operation of the Elesco exhaust steam injector, has just been issued by the Superheater Company, New York. The theory and advantages of the injector are also briefly covered and test results from the New York, Ontario & Western and foreign roads are given on inserts in the back of the book.

Superheater dampers.—An 8-page bulletin, No. 3, descriptive of superheater dampers, designed to regulate the flow of gases through the large flues when the throttle is open or closed, has been issued by the Superheater Company, New York. Cross-sectional drawings show the damper conditions with different link lengths, also the general arrangement of damper cylinder and rigging and method of pipe lagging for road locomotives.

Expansion boring tools and reamers.—A complete description of the various types of expansion boring tools and reamers is given in catalogue No. 24, which contains 71 well illustrated pages and has just been issued by the Davis Boring Tool Company, St. Louis, Mo. The catalogue contains much valuable information pertaining to where and how to best apply these tools in order to obtain the maximum service from them. The last few pages contain illustrations showing all the various types of tools manufactured by this company and explains for what work they can be best adapted.

Personal Mention

General

C. W. Dysert has been appointed mechanical engineer of the Southern Pacific, Louisiana Lines, with headquarters at Houston, Tex., succeeding J. S. Netherwood.

R. L. Ettenger, formerly consulting mechanical engineer of the Southern, has been promoted to assistant vice-president, mechanical, with headquarters at Washington, D. C.

J. T. Leach, assistant master mechanic of the Eastern division of the Pennsylvania, has been promoted to master mechanic of the Wheeling division, succeeding P. M. Cheesman.

B. M. Swope, master mechanic of the St. Louis division of the Pennsylvania, with headquarters at Terre Haute, Ind., has been transferred to the Buffalo division, succeeding F. J. Huston.

P. M. Cheesman, master mechanic of the Wheeling division of the Pennsylvania, with headquarters at Mingo Junction, Ohio, has been transferred to the St. Louis division, succeeding B. M. Swope.

J. S. Netherwood, mechanical engineer of the Southern Pacific, Louisiana lines, has been promoted to assistant superintendent of motive power and equipment of the Louisiana lines, with headquarters at Algiers, La., succeeding B. M. Brown, whose promotion to chief assistant superintendent of motive power of the lines in Texas and Louisiana was reported in the December issue of the *Railway Mechanical Engineer*.

R. H. Bates has been appointed mechanical engineer of the Chicago Great Western, with headquarters at Oelwein, Iowa. He was born on June 11, 1889, at Altoona, Pa., and graduated from the Williamson Trade School in 1909, attending Northwestern University in 1921 and 1922. He entered railway service as a draftsman in the mechanical engineer's office of the Pennsylvania, with headquarters at Altoona, Pa., in August, 1909, and served in that position until September, 1911, when he was appointed draftsman on the Northern Pacific, with headquarters at St. Paul, Minn. He returned to the Pennsylvania as a draftsman, with headquarters at Ft. Wayne, Ind., in June, 1913, serving until October, 1917, when he entered the United States Army, serving in France from February, 1918, to March, 1919, with the Meteorological Division, Signal Corps. In May, 1919, he re-entered the service of the Pennsylvania lines west as chief draftsman, Northwest System, with headquarters at Pittsburgh, Pa., serving in that position until March, 1920, when he was promoted to motive power inspector, with headquarters at Chicago, which position he held until July, 1920. From September, 1920, to July, 1921, he served as senior mechanical engineer of the Interstate Commerce Commission, Bureau of Valuation, with headquarters at Chicago. He was employed as a car designer and checker of the American Car & Foundry Company, with headquarters at Chicago and New York, from March, 1922, to March, 1923, on the latter date being appointed chief draftsman of the Standard Stoker Company, which position he held until August, 1924, serving as acting mechanical engineer in charge of research and development work from January until June, 1924. On October 8, 1924, he was appointed to his present position as mechanical engineer of the Chicago Great Western, with headquarters at Oelwein, Iowa.

Master Mechanics and Road Foremen

M. A. Vaugh has been promoted to assistant road foreman of engines of the Cincinnati division of the Pennsylvania.

Vernon Hathaway has been promoted to assistant road foreman of engines of the Columbus division of the Pennsylvania.

J. McDonough, division master mechanic of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, has retired.

G. R. Miller has been appointed master mechanic of the Slaton division of the Panhandle & Santa Fe, with headquarters at Slaton, Tex., succeeding W. W. Walker.

G. S. Emrich, assistant master mechanic of the C. & P. division of the Pennsylvania at Cleveland, Ohio, has been transferrred to Akron, Ohio, as assistant master mechanic of the Akron Division.

F. T. Huston, master mechanic of the Buffalo division of the Pennsylvania, with headquarters at Olean, N. Y., has been transferred to the Renovo division, with headquarters at Erie, Pa., succeeding J. B. Kapp, transferred.

John P. Morris, general foreman of the Atchison, Topeka & Santa Fe, at Shopton, Iowa, has been promoted to master mechanic of the Illinois division, with headquarters at Chicago, succeeding J. McDonough.

A. R. Sykes, assistant mechanical inspector of the Missouri Pacific, with headquarters at St. Louis, Mo., has been promoted to master mechanic of the newly created Little Rock division, with headquarters at McGehee, Ark.

E. A. Koschinske has been appointed superintendent of the locomotive shops of the Delaware, Lackawanna & Western at Scranton, Pa., succeeding J. R. Lancaster, resigned. Mr. Koschinske, who was born on February 21, 1888, at Scranton, entered the employ of the Delaware, Lackawanna & Western, in July, 1903.

W. W. Walker, master mechanic of the Slaton division of the Panhandle & Santa Fe, with headquarters at Slaton, Tex., has been transferred to the Pecos division of the Atchison, Topeka & Santa Fe, with headquarters at Clovis, New Mex., succeeding M. H. Haig, whose death was announced in the December issue of the *Railway Mechanical Engineer*.

Car Department

Harry Saunders has been promoted to car foreman of the Canadian National, with headquarters at Readville, succeeding A. Ludon, deceased.

J. A. Roberts has been appointed special inspector of the car department of the Chesapeake & Ohio, reporting to Paul Maddox, superintendent car department.

Shop and Enginehouse

E. C. Hanneman has been promoted to general foreman of the Atchison, Topeka & Santa Fe, with headquarters at Shopton, Iowa, succeeding J. P. Morris.

A. M. Semon, machine shop foreman of the Atchison, Topeka & Santa Fe at Chanute, Kan., has been promoted to assistant roundhouse foreman, with headquarters at Arkansas City, Kan.

A. B. Erickson, formerly gang foreman of the Chicago & Alton at Bloomington, Ill., has been appointed general foreman of the Missouri Pacific, with headquarters at Hoisington, Kan.

J. S. Ford, road foreman of engines of the Chicago, Burlington & Quincy, with headquarters at Aurora, Ill., has been promoted to assistant master mechanic of the Galesburg division, with headquarters at Galesburg, Ill., a newly created position.

P. A. Meyer, general foreman maintenance of equipment department of the Panhandle division of the Pennsylvania at Scully, Pa., has been appointed general foreman of the scrap dock and reclamation plant, Eastern division, with headquarters at Conway, Pa.

Purchasing and Stores

E. L. Cates has been appointed acting division storekeeper of the Minnesota division of the Northern Pacific, succeeding R. G. Becker.

J. C. Neph has been appointed assistant district storekeeper of the Eastern district of the Southern Pacific, with headquarters at El Paso, Tex.

John W. Cockrill has been appointed division storekeeper of the Illinois Central, with headquarters at Clinton, Ill., succeeding R. E. Downing, resigned.

A. L. Tucker, assistant general storekeeper of the Chicago & North Western, with headquarters at Chicago, has retired on pension after 45 years of service with the North Western.

R. G. Becker, division storekeeper of the Minnesota division of the Northern Pacific, with headquarters at Staples, Minn., has been transferred to the St. Paul division, with headquarters at St. Paul, Minn., succeeding W. L. Peabody, who has been assigned to reclamation work at Brainerd, Minn.

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Order your indexes

Indexes for the twelve issues of the *Railway Mechanical Engineer* published during 1924 are now ready for distribution. These are sent only to those of our subscribers who place orders for them with our circulation department, as it has been found that many of our readers have no use for them. If you wish to have a copy to include with your bound volume, or for use in referring back to the unbound copies, your order should be placed at once.

Safety appliance violations

One of the most prolific sources of violations of the United States Safety Appliance Laws is at interchange points. One road delivers cars to another with defective safety appliances and the receiving road moves them to its yard, thus making two distinct violations of the law, one by each carrier. This situation should not exist, as the law is well established that the delivering road cannot legally offer in interchange cars with defective safety appliance equipment. The law permits only such movement by the carrier on whose line the equipment becomes defective as is necessary for the repair of the defective appliance, and then only when such movement is necessary for purposes of repair. The movement to an interchange track cannot be justified as a movement for the purpose of repair. The receiving carrier cannot legally move the car, even for the purpose of repair, as it did not become defective on its line of road. The remedy for this situation lies in adequate inspection and proper repairs prior to assembling the cars for interchange movement, thereby eliminating the necessity of refusing such equipment on the part of the receiving carrier as well as the extra handling involved to make the repairs after the cars have been offered for interchange.

Fuel economy at power plants

Elsewhere in this issue is an article entitled "Fuel economy at Southern Pacific power plants," which deserves the careful study of every mechanical department officer responsible for the efficient operation of railway power plants. Many power plants need improvements which would involve considerable capital expenditures. It is also true that hardly any power plants are so efficiently operated that further economies cannot be made by the careful attention to certain minor defects capable of correction at small expense. The article referred to describes a comprehensive plan for improving the efficiency of operation of 94 stationary boiler plants located at various points on the Texas Lines of the Southern Pacific. The total cost of the oil consumed at these plants in 1923 was over $600,000, so the possibilities of saving were correspondingly great. When the work of making the improvements is completed it is anticipated that at least $125,000 will be saved annually, with an expenditure for minor improvements not exceeding $25,000.

The article is especially valuable because it shows in detail the improvements made, their cost, and the savings effected at one of the 94 terminals, namely, the passenger locomotive terminal at Houston, Texas. In this particular case the saving was $15,000 a year, or 38 per cent of the total 1923 fuel cost at that point. Some of the improvements made at Houston include such small but important items as the installation of oil-measuring meters, removal of dead-end steam pipes, insulation of boiler drums and steam pipes, repairs to dampers, installation of soot blowers, etc.

It has been said that the subject of the economical operation of stationary boiler plants is one which the railroads in general have neglected. Whether that is true or not, the experience of the Southern Pacific seems to indicate that it will pay to make a careful check at every railway power plant and ascertain if the proper attention is being given to economical operation.

Uniform location for conductor's valve

Among the subjects discussed at a recent meeting of the Manhattan Air Brake Club was "what should be the proper location of the conductor's or emergency brake valve." The interior design of many of the modern types of passenger equipment do not permit a cord from the conductor's valve to be run through the car. Some roads have abolished the cord in order to remove the temptation of an excited passenger to pull it. Thus, in case of an emergency necessitating the use of the conductor's valve, the trainman must go to the valve itself, which is usually located at one end of the car. Some of the cars recently built have a conductor's valve at each end, but this practice has not been extended to all types of equipment now being built, the design of which prohibits the use of a conductor's valve cord.

The importance of having the conductor's valve in a location of easy access to the members of the train crew should not have to be explained to any one familiar with passenger train operation. The function of the conductor's valve is in many respects the same as that of a fire alarm box in a factory or large office building. In a great many states the installation of such devices is demanded by a law, which usually provides for periodic inspection and demands that the floor space around the fire alarm box be kept clear of obstruction and easy of access at all times. This idea might also be used to good advantage in the selection of a location for the conduc-

tor's valve. Like a fire alarm box, the conductor's valve is seldom used but when it is used, it is usually badly needed.

The question of a standard location for the conductor's valve for all passenger equipment not equipped with a cord, should also be given consideration. Few trainmen take the trouble to ascertain the location of the conductor's valve in all of the cars in a train before starting out on a run and even if this were done, they would probably not remember if an emergency should arise. Perhaps if the valve was placed in a standard location for all passenger equipment considerable confusion might be avoided at an inopportune time.

The members of the Manhattan Air Brake Club have submitted this question for the consideration of other air brake clubs throughout the country, and it is hoped that consideration will be given to this important subject by the proper committee of the Air Brake Association. A number of accidents have occurred in recent years through the misuse and nonuse of the conductor's valve and there is no reason why they could not be prevented to a large extent by seeing that this valve is properly located.

Make use of the test plant

Elsewhere in this issue will be found a description of a locomotive which represents one of the most important pioneer efforts in locomotive design and proportions which has ever taken place. The principal purpose of the design is to make available the possible increase in thermal efficiency offered by the use of high steam pressure. In adapting the locomotive to the development and use of steam at 350 lb. boiler pressure, two outstanding departures have been made from the usual type of locomotive construction. One of these lies in the boiler in which a large amount of stayed heating surface in the firebox has been replaced with water tubes. Indeed both the construction and the proportions of this boiler are so different from anything heretofore employed in American practice that it would be difficult to predict just what results it will produce, either as to maintenance or steam production performance. The other innovation is the reintroduction of cross-compound cylinders, which disappeared from American practice about twenty years ago.

The real test of a locomotive is its performance in actual road service. This, and this alone, can determine the practicability of the mechanical design both from the operating and maintenance standpoint. After this has been determined, however, assuming that the verdict is favorable to the fundamentals of the new design, much more is necessary before a sound engineering basis will be available on which to make the most effective use of the principles back of the new design. In this case, for instance, it has been estimated partly on theoretical considerations and partly on the basis of experience with other types, that the special features of the new locomotive will effect a combined fuel economy of about 39 per cent in fuel consumption per horsepower-hour as compared with locomotives of straightforward conventional design and proportions.

It is tremendously important for the future development of the steam locomotive in America that accurate data be made available on which may be determined the extent to which these estimates are justified, and this data should be determined in such detail that its analysis will give a clear idea of the relative value of the different factors which go to make up the overall result. Such data can best be made available by operating the locomotive on a testing plant and, unless the preliminary road service trials prove the locomotive to be a complete failure, it will be unfortunate indeed for American railroads if complete test plant results for this locomotive are not ultimately made available.

More specialized men needed

One of the things most needed to increase the efficiency and general effectiveness of railroad mechanical departments is a larger staff of better paid, more highly specialized men in charge of the various branches of maintenance of equipment work. It is not the intention in this editorial to discuss the question of how many men a shop foreman or gang leader can efficiently supervise, although this question is a timely one and of great importance. It is of still greater importance, however, to the railroads, that adequate general supervision be provided for this department, to which is assigned the tremendous task of maintaining the cars and locomotives in this country in condition for safe and economical operation.

Without attempting to make an impression with large total figures, some idea of the magnitude of the work may be gained from the statement that on quite a number of individual railroads in the United States the labor payroll in the mechanical department for 1925 will exceed 20 million dollars, and the expenditures for material 80 per cent of this sum in addition. Statements have been made comparing the efficiency of the conduct of modern industrial enterprises and the railroads to the disadvantage of the latter. If railroad mechanical departments are not as efficient as they might be—and where is the railroad officer who would say they are—may not the trouble be lack of adequate, specialized, general supervision? What business involving the expenditure of 36 million dollars annually for labor and material would expect to conduct its affairs without a board of directors, president, series of vice-presidents, general manager, district managers and other general officers, not only exceeding in number the staff of the average superintendent of motive power but receiving vastly higher salaries?

In the opinion of the *Railway Mechanical Engineer* the average mechanical department executive in the general office is loaded down with duties in excess of his capacity to handle them efficiently and his difficulties are accentuated by the fact that the railroad is an institution primarily of length, with shops, terminals and power plants located at various points from one end of the system to the other. In other words, the officer must spread himself over a great deal of territory, spending much time in travel which the ordinary business executive can utilize by getting further into the details of his business. In view of this condition it would be reasonable to suppose that the railroads should have more, rather than less, general supervision than that found necessary in other industries.

Many instances could be cited to show the load under which mechanical department officers are expected to labor and yet produce approximately 100 per cent results. The general superintendent of motive power of one of the large midwest railroads is known to spend practically all his waking hours, usually not less than 17 out of each 24 hours, traveling, studying problems and making decisions either directly or indirectly connected with the conduct of the vast property over which he has general supervision. With little or no vacation, this man labors year in and year out and it is a continual source of surprise to his staff and acquaintances that he does not break down under the nervous strain of attempting to perform all the duties which in his opinion require the personal

attention of the officer in charge of the mechanical department.

Another case might be mentioned in which the general machine tool expert of a big railroad system is also responsible for the general efficiency of operations in all the shops. In this capacity he is installing a bonus system at one shop on the road. In addition, he sometimes instructs the apprentices, and, while it seems hardly credible, it is also reported on good authority that when an epidemic of rod failures, stoker failures, or what not, occurs, this combination machine tool expert, production engineer and apprentice instructor is sent out to investigate and report on the trouble.

The case cited may be extreme, but it certainly indicates in no uncertain way how short-handed some mechanical departments are in the general office. Let us have more specialized men, better trained and better paid, to exercise general supervision over the various important branches of mechanical department work.

Machine tools improve in design

During the past year the *Railway Mechanical Engineer* has published in its New Devices section 192 descriptions of various types of machine tools which could be used in railway shops. To one who has followed these descriptions, the progressiveness of the machine tool manufacturers in developing equipment to meet the large variety of conditions encountered in the railway shop is evident from the numerous designs of new and improved machine tools and auxiliary devices that are continually being introduced. A review of the recent developments of modern equipment shows a number of well defined trends, a knowledge of which may well prove of interest and value to those whose duties require them to make the final selection in the purchase of new tools.

The selection of a tool is first based on the primary requirements for which the tool is intended. These may be either representative production, accurate production, simplicity of design, or adaptation to a wide range of work. The efficiency of a given machine and its durability under service conditions are points that have a most decided influence upon the design and general arrangement. Consideration must also be given to the preservation of the original accuracy of alinement between important machine tool members by reducing wear and by adequate means of compensating for unavoidable wear. To obtain this result in a machine tool involves not only the design of adequate bearing surface for the use of special bearings, but effective lubrication and protection against dust or gritty material that might injure the bearing surface.

One of the outstanding characteristics in recent machine tool design has been the care given to the proper location of levers relative to the operator's normal working position. Considerable progress has also been made in reducing the number of controls as well as in simplifying their arrangement. The designers' object in focusing their attention upon these features has been to increase the output of the operator through the convenience of the control mechanism and to safeguard both the operator and the machine itself. The methods of transmitting power in machine tools either for driving the cutters or the work, or for feed movements, have been subject to constant improvement. One of the principal improvements in this respect is the use of helical gears for connecting parallel shafts. This method of gearing provides smooth transmission free from injurious vibrations. The use of special steels and heat treated gears is also becoming quite general, the hardened gears in some cases being ground to eliminate even the slightest distortions caused by heat treatment. Again, considerable attention has been given to the methods of controlling speeds and feeds. They are being simplified considerably so that operators can readily determine how to make changes, thus being encouraged to alter speeds or feeds whenever advantageous from the viewpoint of production.

Almost without exception in every machine of major importance which was described in the pages of this magazine last year the motor drive was an integral part of the machine. Improved methods of mounting the motors have been devised, in order to minimize vibrations and to make the motor an integral part of the general design. Where suitable interior space is available the motors have been installed inside the base or frame of the machines. The object of this is to protect it from dust and dirt and conserve valuable floor space. The use of variable speed transmissions of the geared type has been eliminated in certain machines by arranging the motors to give speed variations which can be used for securing different changes of speed when required. Independent motors are also being used for the movement of different parts of some machines. For example, a recent design of a heavy duty vertical boring mill includes a separate motor for power rapid traversing the saddles and tool spindles, and a planer recently put on the market has a separate motor for moving the cross rail and side head.

The hydraulic form of transmission has replaced the mechanical transmission on certain machine tools and the present trend is toward a wider application of the hydraulic type. This form of transmission is utilized with the idea of obtaining an unusually smooth action and flexibility of control that is beyond the range of mechanical transmission. This type of transmission has been utilized more particularly for grinding machines. Some applications have also been made on woodworking machinery.

In the class of service for which the average railway machine tool is used, the vibration set up in it should be reduced to the minimum. There are many methods used by the builders to eliminate vibration. One of the methods employed in accomplishing this result is the use of massive members that are much stronger and heavier than are required for strength alone. The manufacturers also have paid particular attention to torsional vibration. A car wheel boring mill was recently designed with special attention paid to the elimination of vibration. The housings are bolted, dowelled and tongued to the extension and tied together on top of a heavy box arch.

More attention is being paid to the lubrication of machine tool bearings owing to the higher speeds and bearing pressures incidental to the high duty operation required of the tools. Lubrication is accomplished in some cases by a pump and a centralized special tank with circulation to the moving parts and back to the pump. In others the splash system or an oil-tight case for submerged lubrication is used. The automatic control of the flow of cooling compounds or oils, to facilitate reloading and inspection of work, is another feature that is becoming common to certain designs of machine tools.

The review given here is necessarily incomplete. But it is evident that the machine tool manufacturers are constantly introducing designs which, in many instances, represent a vast amount of research and experiment. The railroads ultimately benefit by this research when they buy new machine tools which, if properly used, increase their production and materially reduce the cost of the maintenance of cars and locomotives.

New Books

Recent Progress in Engineering Production. *By C. M. Linley, consulting engineer. 340 pages, illustrated. 7 in. by 9½ in. Price 42 s. Published by Ernest Benn Limited, 8 Boverie street, E. C. 4, London, England.*

The cost of production is the most serious problem confronting industry today. The main direction in which economy of operation can be sought is obviously in the employment of the most up-to-date time and labor saving machines and appliances. This book contains 51 well illustrated chapters dealing with all kinds of machines and appliances used in the industrial field. It covers the products of machine tool builders of the United States and England and describes the machines built in both countries which the author believes to be best suited for the particular class of work which he may be describing. The book will serve as a reference work to those in the industrial field whose duties require them to select machines for various classes of work.

Aside from that part of the text dealing particularly with machine tools and their uses, the author has described in a general way the equipment and practices common to case hardening and heat control, metal cutting by means of machine controlled oxygen jets and has included chapters on pattern making, and the use of aluminum alloys with a brief description of extrusion processes. As a whole this book constitutes a broad treatment of modern industrial plant equipment and practices.

Arc Welding and Cutting Manual. *A 127-page, 7¾ in. by 10½ in. illustrated manual. Published by the General Electric Company, Schenectady, N. Y.*

The purpose of this manual is to acquaint the uninformed in a general way with some of the applications of arc welding, and to provide a simple and logical method by which one may acquire a certain familiarity with the manipulation of the electric welding arc and its characteristics. The volume is well illustrated with photographs, diagrams and charts, explanatory of the text. It is divided into three parts, the first devoted to general information on arc welding, the second to a training course for operators and the third giving a number of applications of arc welding.

The general information deals with polarity and the source of welding current for the arc. The characteristics of a good arc are pointed out. Considerable attention is given to electrodes and accessories. The training course for operators is a timely subject and is developed in the text in such a clear manner that it can be readily used as a framework to organize a training course for operators by those who are desirous of obtaining skilled workmen. The welding of cast iron, manganese steel, structural steel, steel and iron alloys and non-ferrous metals is taken up from all practical angles. The manual should prove valuable in practically all industries and trades.

Handbook of Wooden Car Repairs. *By E. W. Hartough, formerly general car foreman, Missouri-Kansas-Texas, Pere Marquette, 219 pages 4½ in. by 9½ in., illustrated. Price* $2.50. *Published by the Simmons-Boardman Publishing Company, 30 Church street.*

The author describes the construction of and the repairs made to wooden cars, gondolas, box and stock cars, refrigerators and cabooses. Sections of the book are devoted to freight car roofs and car doors for all classes of house cars, both wooden and steel.

Part I deals with wooden flat cars and gondolas. General descriptions of these cars are given, particular attention being paid to sills and attachments, car floors and timbers liable to failure. The most economical methods of making repairs are then discussed. Part I concludes with an interesting explanation of brake gear. It takes up the methods of calculating the pull exerted by levers and total braking pressure. The fundamental brake gear is described. Attention is called to the results obtained by making wrong lever combinations.

The wooden box cars are taken up next with considerable attention to the methods of repairing the car body. This is followed by a discussion of stock and refrigerator cars and cabooses. An interesting explanation is given about insulating materials for the car body. The defects developed in insulation and in car construction are pointed out with suggestions as to how to make proper repairs. The standard types of ventilators and the ventilated and heated refrigerator cars receive considerable attention. Part 5 explains the various types of freight car roofs in use today. Their defects and remedies are clearly explained. The book concludes with a discussion of the construction, defects and method of making repairs to freight car doors.

Car Truck and Draft Gear Maintenance. *By E. W. Hartough, formerly general car foreman, Missouri-Kansas-Texas and Pere Marquette Railway. 158 pages, 4½ in. by 7½ in., illustrated. Price* $2.00. *Published by the Simmons-Boardman Publishing Company, 30 Church street, New York.*

The work of the railroad carman is so diversified that the writing of an average size book on the entire subject of car repairs would result in many important details receiving but scant attention, or being omitted entirely. This volume deals only with the construction and maintenance of car trucks and draft gears. For the sake of easy reference, five distinct separations have been made. Sections I and II cover arch-bar truck repairs, and Section III is devoted to the subject of cast steel and pressed steel side trucks. Sections IV and V go into draft gear repairs.

The first part of the sections dealing with car trucks goes into a detailed description of the general construction and operation of a freight car truck. Mention is also made of the causes and the methods of failure of the component parts. This is followed by the more important subject of repairs, including a description of the methods and the apparatus actually employed in car repair yards to repair the damaged parts of a truck in an efficient manner. Each part of the truck is considered in detail, beginning with general operations, such as jacking and the removal of bolts and nuts, and proceeding to repairs of a more easy nature, such as those that deal with the component parts of the truck side. The section on car trucks closes with a general description of trucks with cast steel or pressed steel side-frames, rigid bolster trucks and others constructed with the purpose of evolving a truck that will possess a maximum number of advantages with a minimum number of defects. Particular attention is given to the features which provide special advantages in assembling or that secure more efficient operation.

Sections IV and V pertaining to draft gears open with a detailed description of the construction and operation of the A.R.A. standard *D* type coupler. This is naturally followed by a discussion of the various types of draft arms in use and the methods of repairing them. Spring gears are considered first including a description of the construction, operation of parts liable to failure and methods of repair of the more common spring gears in

present day use. The concluding chapters deal with the numerous types of friction draft gears and methods for repairing them.

PULVERIZED FUEL, COLLOIDAL FUEL, FUEL ECONOMY, AND SMOKELESS COMBUSTION. *By Leonard C. Harvey. 466 pages, illustrated, 7½ in. by* 10 *in. Price* $18.00. *Published by the Macmillan Company, New York.*

This book presents to the reader the results of a thorough and intensive study of the various applications of pulverized fuel. A large part is devoted to the describing of successful systems for handling and burning this type of fuel in power plants as well as in the metallurgical and railway industries. The author has given the underlying principles and has shown the advantages and disadvantages that are liable to be incurred in the use of pulverized coal. In this, he has presented numerous extracts from the writings of engineers and scientists of many nationalities and has also shown the results of practical work performed by experts.

The book has 17 chapters, the first six of which are devoted to a contrast of past and present day practices, a discussion of the combustion of pulverized fuel, fuel conservation, the difficulties to be encountered in handling pulverized fuel and the various systems of washing and conveying. The remaining chapters are devoted to the application of pulverized fuel to various industries. Chapter 15 gives a discussion of the firing of locomotive boilers with pulverized fuel. This chapter gives an account of the most recent applications on various railroads both in this country and abroad. It also contains the results of comparative tests run with pulverized and lump coal and gives an interesting account of the various difficulties that were encountered and eventually overcome. The remaining portion of this chapter is devoted to descriptions of the various types of equipment. The last chapter contains an appendix which includes tables and data on combustion and firing efficiency, air mixtures and water vapor, etc. There is also a list of pulverized fuel installations in various parts of the world and a bibliography of recent articles and publications on this subject. The text of the book is well illustrated with drawings and photographs.

What Our Readers Think

Reclaiming files

CEBU, P. I.

TO THE EDITOR:

In the November, 1924, issue of the *Railway Mechanical Engineer,* James Sheridan of the Copper River & Northwestern, raised a question concerning the reclamation and recutting of files. I have had some experience in the reclamation of files with acid solutions and with the sand blast machine. There are various formulas for acid solutions.

Formula No. 1—Boil the files in a strong soda solution to clean off all grease, oil or gum, then dip for a few minutes in a bath of one part nitric acid and two parts water. The length of time is less on a fine file, as experience may suggest.

Formula No. 2—Wash the file in a warm potash solution to remove the grease and dirt, then wash in warm water and dry by heat. Put 1½ pints of warm water in a wooden vessel and place the files in it; add 3 oz. of finely powdered blue vitriol and 3 oz. of boric acid. Mix well and turn the files so that every one comes in contact with the mixture. Add 10½ oz. of sulphuric acid and ½ oz. of cider vinegar. Remove the files after a short time, dry thoroughly and rub them with olive oil, then wrap in porous paper. Coarse files should be kept in the mixture for a considerably greater length of time than is necessary for the fine ones.

The above formulas are for files that are not wearing out, but only such files as have been used on soft metals, such as brass, copper and white metals. The teeth become filled up with the metals. It is believed that the most economical process for the reclamation of files is the sand blast machine.

J. T. BOOTES,
Division foreman, Philippine Railway.

Using dividers to set valves

PORTLAND, ME.

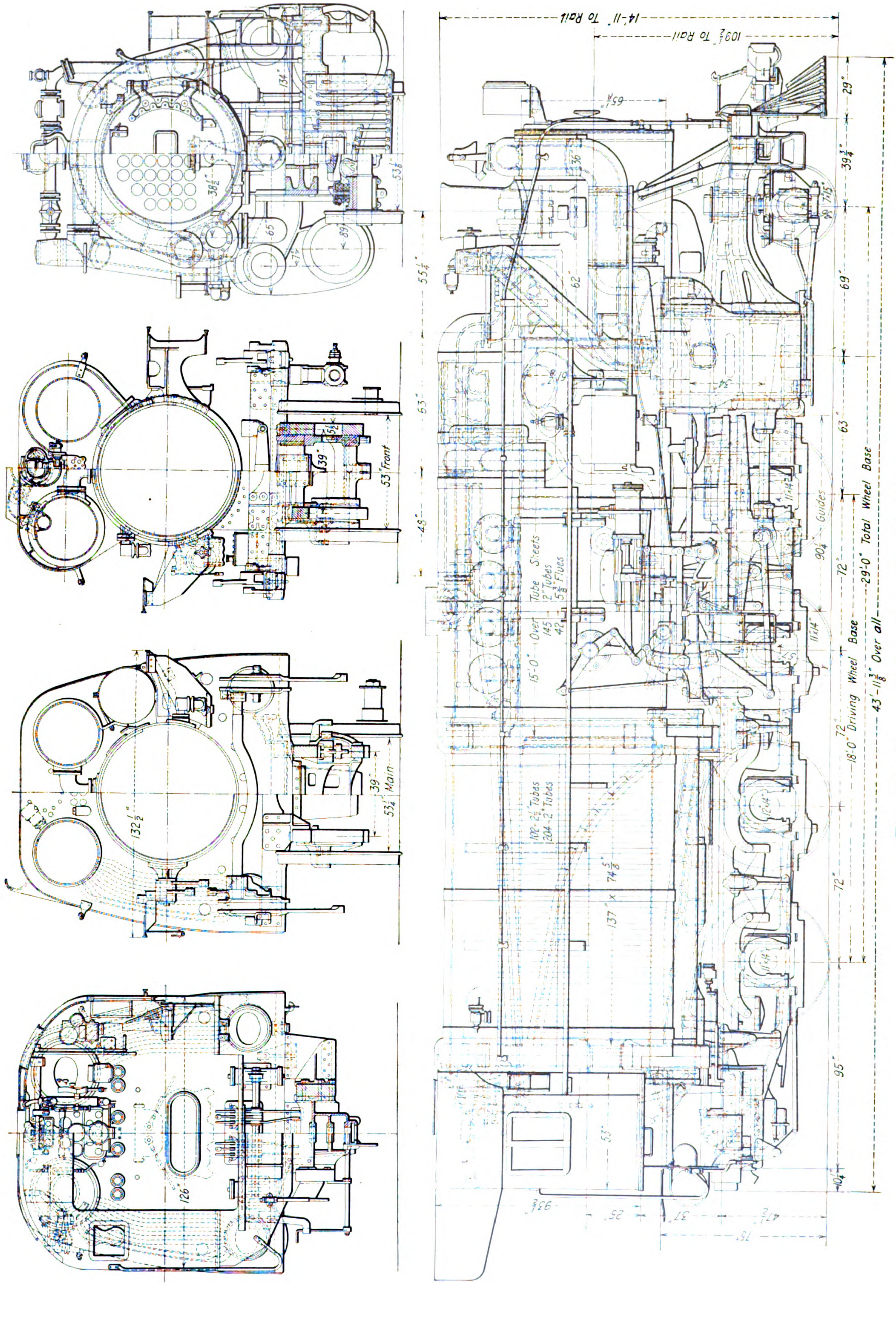
TO THE EDITOR:

I have been reading Mr. Stowell's article on "Helpful Suggestions for Setting Locomotive Valves," which appeared on page 596 in the October issue of the *Railway Mechanical Engineer.* I don't want to criticize his method but I think that the fewer figures used the less liable there are to be mistakes. I have been setting valves for ten years and do most of my work with dividers. I make it a practice of turning wheels backward, with the reverse lever in full gear ahead when getting quarter marks. After marking each dead center I roll the wheels forward and obtain the lead marks. This will give all four centers and lead marks for the head gear. Then get the lead marks for the back gear, in the same manner. The next operation is to set the crank. If it is to be set at right angles to the pin the front lead marks must measure the same distance apart as the back ones. If they do not then this is the point where the dividers are used. Let *a, b, c, d* represent the lead marks $\frac{a. \quad b.}{c. \; F. \; d.}$. Set the dividers *a b* and mark on a line on some convenient smooth surface $\frac{a. \quad b.}{c. \quad d.}$. Then set for *c d* and mark *a d.* If the lead marks are equal they will measure *a c.* Remember that we are in the back gear. Between *c* and *d* mark lightly the center *F.* Now set the dividers one-half of *a c,* and using *F* as the center, move the crank so that *c* or *d* according to the end of the stroke, will come under the other leg of the dividers.

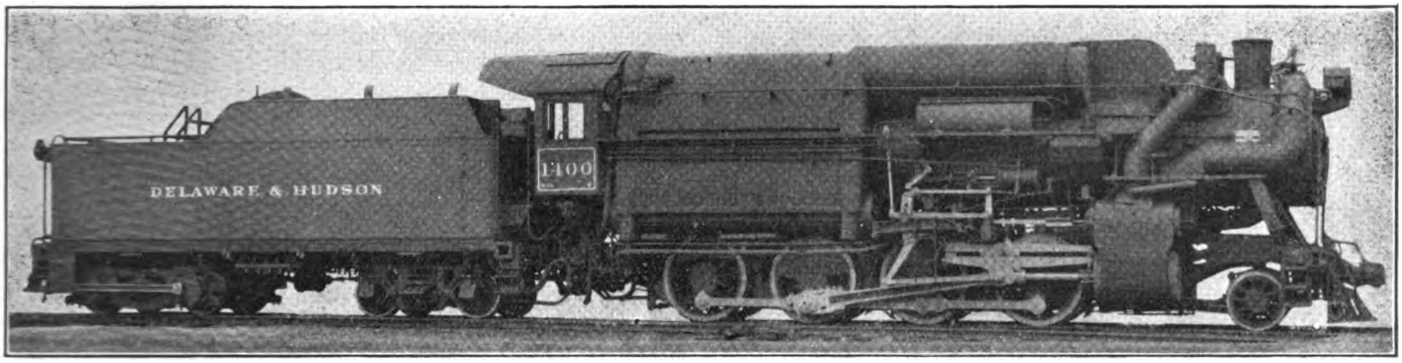
One revolution of the wheel in each gear is usually sufficient to prove the work. If the eccentric needs to be changed, the center foreward gear marks and the reverse gear center marks must come together when correct, so move the eccentric rod according to the motion. If the engine is in direct motion in foreward gear, the reverse gear mark needs to go ahead and it follows that the crosshead must come back. To do this, shorten the eccentric rod one-half of the distance between the centers multiplied by three. (It is understood that the fixed point of the tram is on the crosshead guide and the crosshead moves under it.) After getting the lead marks right, get the port marks and move the valves on the stem by adjusting the nuts to equalize them with the lead marks. By this method the wheel roller can be put under the engine and the setting completed in one day ready for the side rods, providing of course, that there are no new main pins to have key-ways cut in.

I would like to hear from others on this subject.

W. C. SPARROW.



Elevation and cross sections of the "Horatio Allen"



The "Horatio Allen" developes 104,000 lb. maximum tractive force, including the tender booster

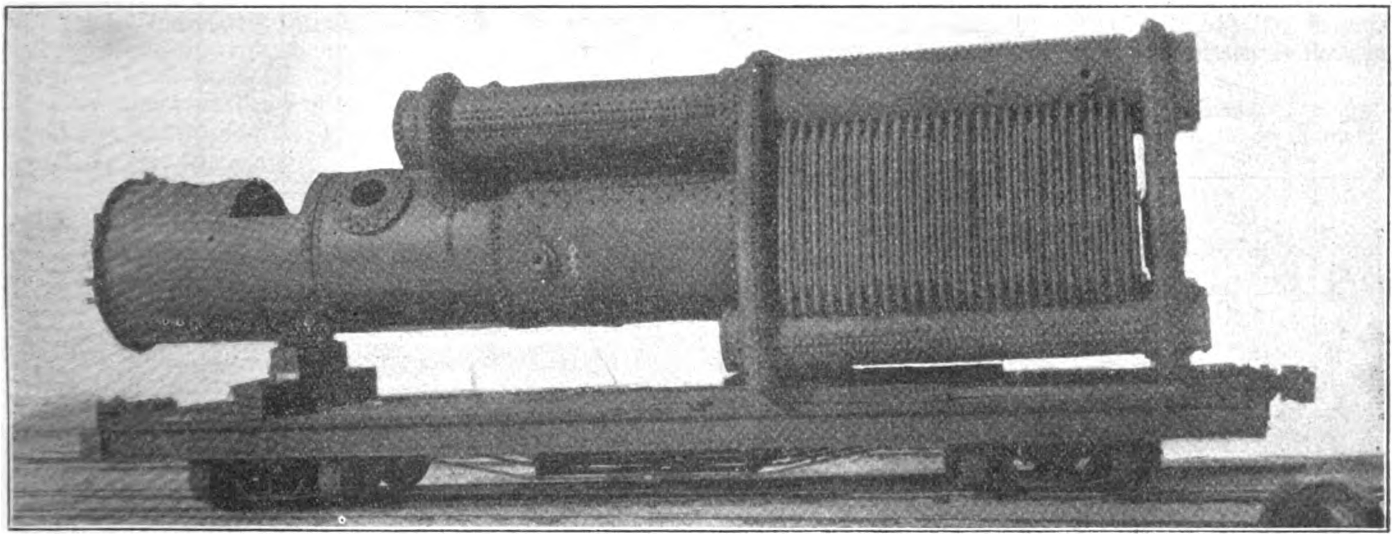
The "Horatio Allen," a high pressure locomotive

Water-tube firebox contains 37 per cent of total heating surface—Cross-compound cylinders

ON December 4, 1924, the Delaware & Hudson, with ceremonies fitting the occasion, christened a new Consolidation type locomotive of unique design, the "Horatio Allen," in honor of the engineer who was responsible for the building of and was the first operator of the "Stroubridge Lion," which went into service on what is now a part of the Delaware & Hudson on August 8, 1829.

The design of the new locomotive was developed by John E. Muhlfeld, consulting engineer for the railroad, and it was built by the American Locomotive Company. Naming it after a pioneer in steam locomotive development is suggestive of its character as, in effect, it represents a pioneer attempt to increase the thermal efficiency of the locomotive by employing the greater expansive range made possible by steam pressures much higher than are now employed in conventional locomotive designs. There are also a number of interesting details of construction in which conventional design has been departed from, aside from those made necessary by high steam pressure.

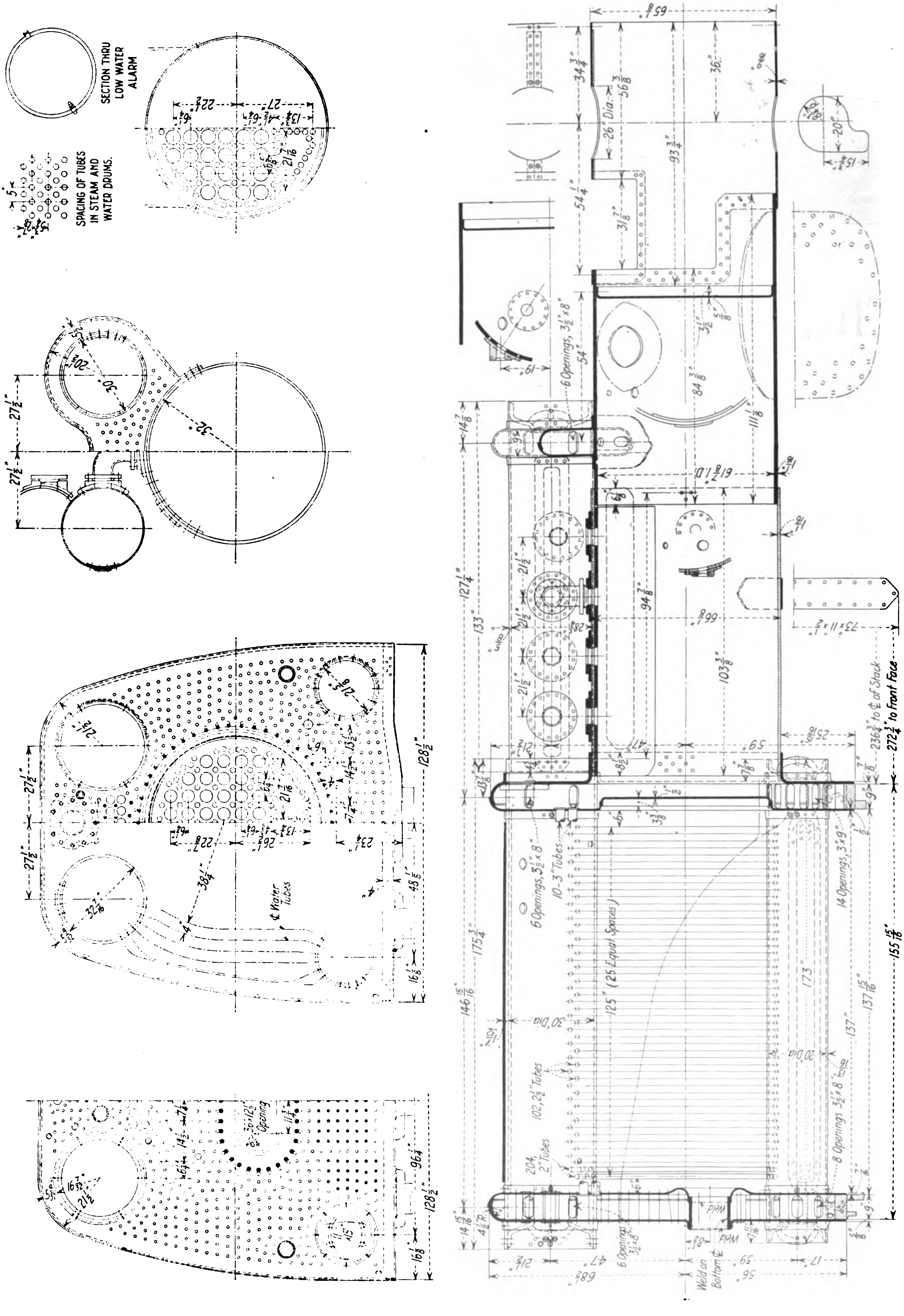
The "Horatio Allen" is of the Consolidation type weighing 297,000 lb. on the drivers, with tractive force ratings of 104,000 lb. simple including the tender booster, 84,300 lb. simple for the engine alone, and 70,300 lb. compound. The locomotive carries 350 lb. boiler pressure and works steam expansively in cross-compound cylinders of 23½-in. and 41-in. diameters, respectively, by 30-in. stroke. The driving wheels are 57 in. in diameter. In actual service the locomotive has developed drawbar pulls of 105,000 lb. at starting simple with the booster cut in; 95,000 lb. in simple gear at 4 miles an hour; 75,000 lb. in compound gear at 5 miles an hour; 65,000 lb. in compound gear at 10 miles an hour, and 53,000 lb. in compound gear at 18 miles an hour.



The complete boiler before the application of the firebox lagging—The man-hole in the front barrel course gives access to the interior in the absence of a dome

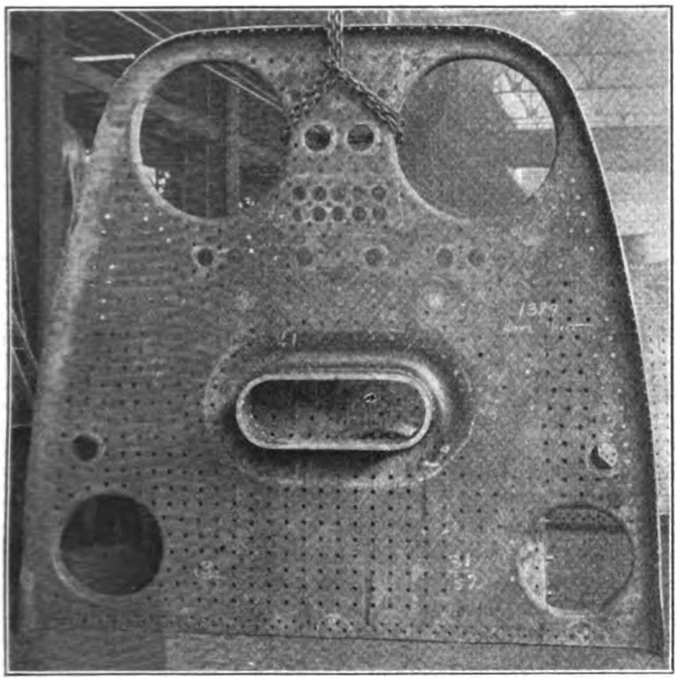
The boiler

The boiler represents a complete departure from customary locomotive design. Its construction is clearly shown in the drawings and photographs. The back head and rear tube sheet connections of the firebox are both of



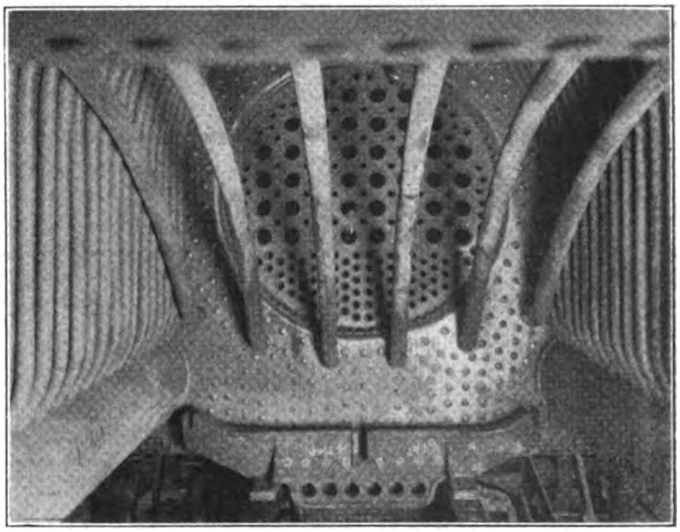
Longitudinal section, cross sections and back head elevation of the boiler

similar construction. They are 9-in, water leg headers composed of parallel stayed sheets, flanged and riveted together around the top and sides and secured to steel foundation castings at the bottom. Circular openings through each of these members near the lower corners receive water drums, 20 in. in inside diameter. These



The inside sheet of the back firebox header

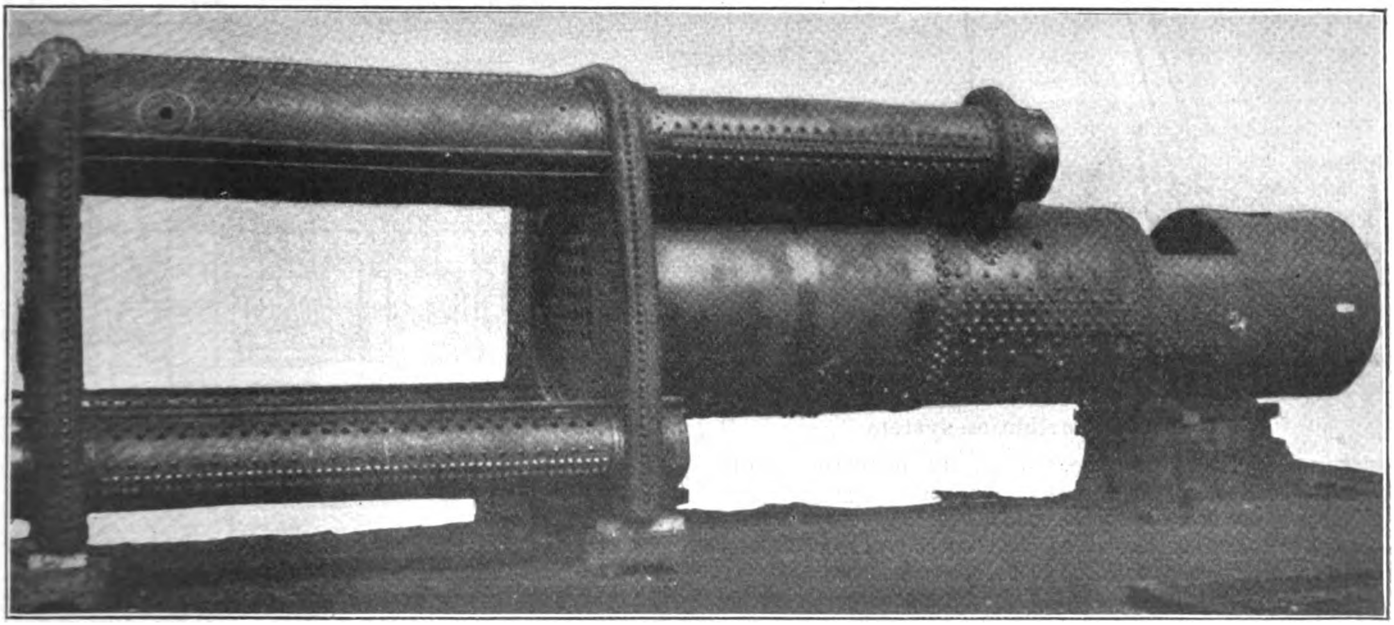
drums pass completely through both of the headers, and ports are cut through their shells in the header water spaces. The 30-in. steam drums at the top are secured to the front and back headers in the same manner. These drums are in two courses, the front course fitting inside boiler barrel. The ends of all four drums are closed with internally projecting heads and hand-hole covers. Referring to the boiler drawing, it will be seen that four pipe connections lead out from the top of the boiler barrel between the forward extensions of the steam drums and connect alternately into the two drums thus adding considerably to the freedom of communication between the boiler barrel which is completely filled with water, and the drums, the upper parts of which constitute the steam



Interior of the firebox before the arch or grates were applied

space of the boiler. The front sheet of the forward firebox header is flanged outward to receive the back course of the two-course boiler barrel, which is 66⅛ in. in outside diameter. The inside sheet of this header is flanged inward to receive the firebox tube sheet.

The heating surfaces at the sides of the firebox are composed of 306 tubes, 102 of which are 2½ in. in diameter

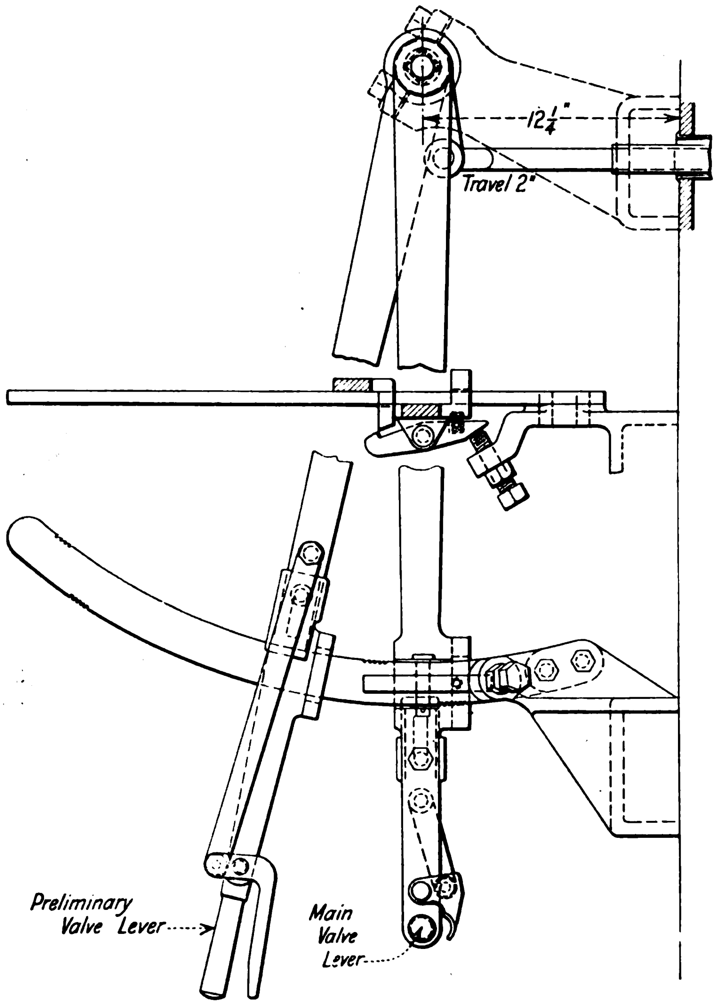


The boiler before the application of the water tubes

the rear course and extending 133 in. forward along the boiler shell. The front ends pass through a stayed saddle secured to the top of the boiler barrel and ports through the drums and through the boiler shell provide for communication through the saddle between the drums and the and 204 of which are 2 in. in diameter. These tubes are expanded into the top and bottom drums. It is thus evident that the amount of stayed surfaces has been considerably reduced and are flat, parallel surfaces, with the exception of the small area of the firedoor flange. The

drum and header type of construction, with the top headers carried forward and securely attached to the boiler barrel also provides an extremely rigid structure.

Additional heating surface is provided in the firebox by ten 3-in. longitudinal water tubes which lie between the upper drums and connect the front and back stayed headers. There are also six 3½-in. arch tubes. The arch in this locomotive is unbroken from the tube sheet to the door sheet, thus completely dividing the unobstructed firebox volume into two parts. This directs the hot gases and flame outward at either side and up through the staggered rows of water tubes, thence inward



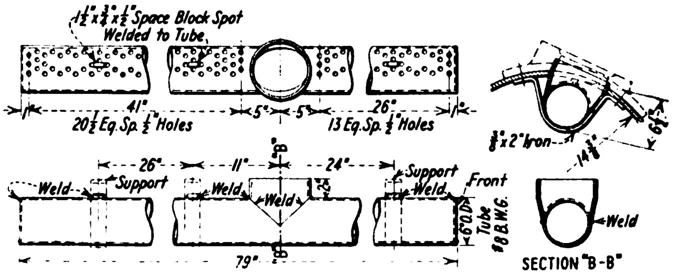
The operating levers for the main and auxiliary throttle valves

to the combustion chamber volume above the arch and into the fire tubes.

The steam distribution system

Steam is taken from the tops of the forward sections of the steam drums. A welded collector pipe of ¼ in. steel, 6 in. in outside diameter and 79 in. long, is suspended from the top of each drum. The upper surface of each of these pipes is perforated with several rows of ½-in. holes, through which the steam enters, thus distributing the gathering of the steam over a large water surface and removing any tendency for a local surge to lift the water. From these pipes the steam passes out of the drum into a yoke header casting between the drums, to the front flange of which is bolted a Sanford-Riley Stoker Company's desaturator. This is of the centrifugal type, the whirling of the steam through a horizontal spiral passage causing the water to be thrown off and collected at the bottom of the casting, from whence it is trapped back into the boiler. The front flange of the desaturator is bolted directly to the throttle casing.

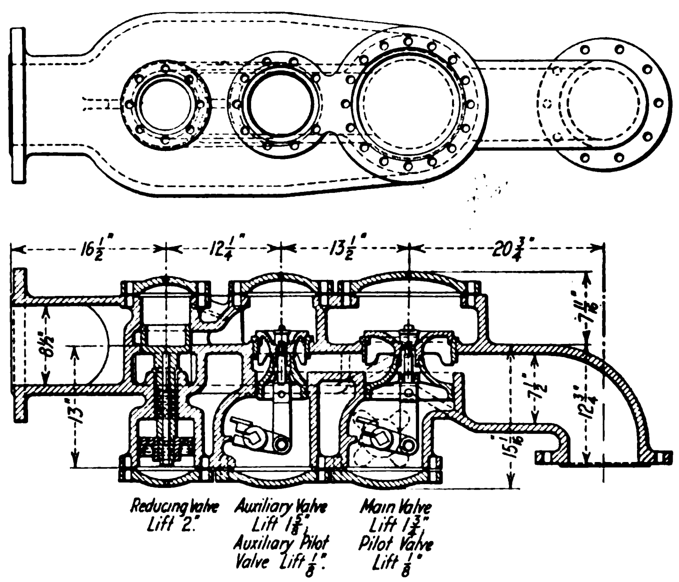
The perforated steam collector has proved so effective in service that very little water is removed by the desaturator and some question has arisen as to whether or not it is actually needed. The overall effect of both the



The steam collector—One of these is located in the top of each steam drum

collector and the desaturator has been found by calorimeter readings to limit the maximum moisture content of the steam to two or three per cent.

The throttle is of unique design, known as the duplex type. There are two throttles, each operated by a separate lever. What is termed the preliminary throttle is used in starting the locomotive. This takes its steam through a reducing valve which limits the pressure to 300 lb. per sq. in. When the locomotive has been started by the use of this throttle, the main throttle may be opened and the two throttle operating levers automatically interlock so that the continued opening of the main throttle picks up and carries with it the auxiliary throttle lever. Closing

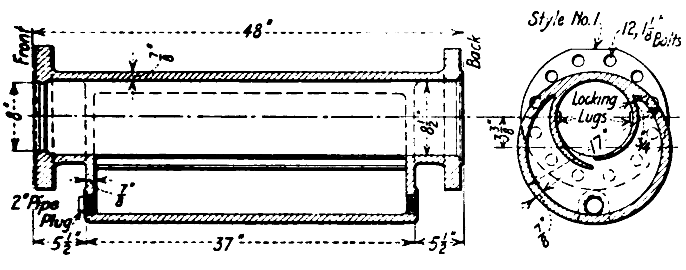


Details of the duplex throttle valve casing

the main throttle unlocks the connection between the two levers so that the preliminary valve lever is free to move independently in starting. The throttle valves are of the Chambers type.

From the throttle the steam flows directly into the superheater header, which is mounted on a cast base over the top of the smokebox. The unit bolts are applied with the nuts at the top of the header, where they are accessible for tightening without opening the smokebox front. This arrangement is clearly shown in one of the drawings. There are 42 superheater units, each of which

consists of a single loop. The unit pipe leading from the saturated steam header is twisted above the return pipe in a spiral and the two pipes are threaded and welded into a cast steel return bend which is located 12 in. from the back flue sheet. The whirling motion imparted to the



The desaturator—The steam passage contains a spiral core

saturated steam is designed to bring such moisture as the steam may contain into intimate contact with the unit surface, thus producing a more effective heat transfer. It also serves to equalize the expansion strains on the return bend joints. Steam from the drifting valve passes through the superheater and thus serves to protect the units from overheating, when the throttle is closed.

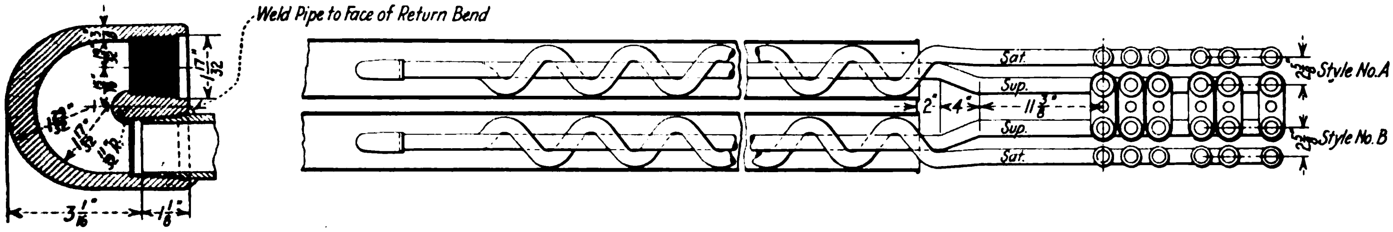
A flange on the right side of the superheater header leads the superheated steam into a branch pipe connection to the high pressure steam chest. In the design of this cylinder, close attention has been given to providing unobstructed flow to and from the valve chamber and special attention has been given to collecting.

The simpling of the cylinders at starting and change to compound operation either automatically at the proper speed or manually at the will of the engineman, is controlled by a Mellin intercepting valve. This valve is inserted in the receiver line and is attached directly to the exhaust cavity opening on the front face of the high pressure cylinder casting. From the intercepting valve casing the receiver pipe is carried forward and over the top of the smokebox in front of the stack, thence back to the valve chest connection of the low pressure cylinder.

The steam distribution is controlled by the Young valve gear, operating a 12-in. piston valve in the high pressure steam chest and a 14-in. double ported piston valve in the low pressure steam chest.

Considerable attention was given to the design of the steam passages to provide ample area free from obstruction. The dry pipe passage up to the throttle is 8½ in. in diameter, except for a flange at the outlet of the desaturator, which is reduced to 8 in. in diameter. From the throttle to the superheater header the passage is 7½ in. in diameter, and this size is retained through to the high pressure cylinder. The passage through the receiver pipe is 10 in. diameter.

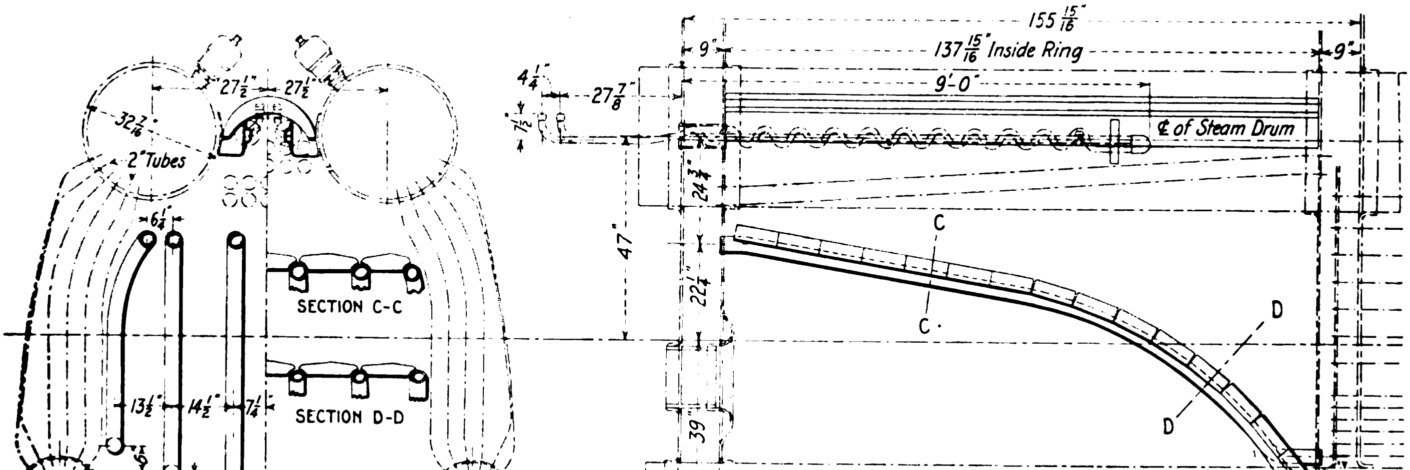
Superheated steam for the tender booster is taken from the high pressure branch pipe where it connects to the main superheater header. Superheated steam for the other auxiliaries is also provided by an auxiliary superheater, the units of which pass into the upper part of the firebox through the tubes in the back header.



How the superheater units are arranged

Frame and cylinder construction

One of the most interesting departures from conventional design is in the frame construction. The main frames terminate just back of the cylinders and the front rails are replaced by a combined saddle, frame and front deck casting of steel. The high-pressure cylinder is secured on the right side and the low-pressure cylinder on the left side. The smokebox saddle fit is made in a separate casting, which is bolted to the top of the main casting.



Details of the firebox arch—The location of the auxiliary superheater units is also shown

This permits the removal of the boiler without disturbing either the smokebox saddle fit or the main frame splice. The details of the main casting are clearly shown in one of the drawings.

The only steam passage cored through the steel saddle casting leads from the exhaust passage of the low-pressure cylinder to the front face of the saddle casting on the center line of the locomotive. From this point an outside exhaust pipe carries the steam forward and up into the exhaust nozzle in the smokebox. The center line of the exhaust nozzle is located 65½ in. forward of the transverse center plane through the cylinders.

Other details

One of the drawings shows the detail construction of the exhaust nozzle. This provides a direct passage for the low pressure exhaust, the diameter of which is 10 in. at the base, reducing to 8¼ in. at the nozzle tip fit. The diameter of the tip at the outset was 5½ in., although this may since have been subjected to adjustment.

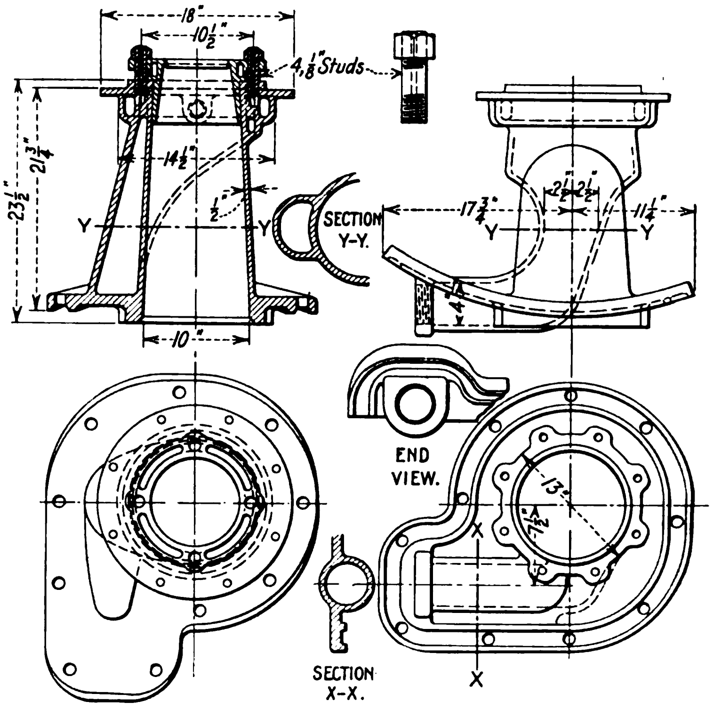
The high-pressure exhaust, when operating simple, is carried from the intercepting valve through a 3½-in. pipe to an opening in the base of the exhaust nozzle casting outside the smokebox. This opening leads to an annular chamber outside the main exhaust passage and discharges through annular openings in the top of the casting. The high-pressure steam connection is a 3½-in. pipe which leads directly into the main steam passage at the top of the steam chest of high-pressure cylinder casting. The location of the intercepting valve in direct connection with the high pressure cylinder not only makes it readily accessible for repair or adjustment, but shortens such pipe connections as are required.

Among the other special features, which may be mentioned in the equipment on this locomotive, is the use of the Owen's system of force feed lubrication, with oil inlets at the bottom of both cylinders as well as in both valve chests. The boiler tubes are fitted with Coleman safe-ends, one of which is illustrated.

The tender, which has a capacity of 9,000 gal. of water and 15¼ tons of coal, is carried on a Franklin tender truck at the front end and an M. & L. tender booster truck.

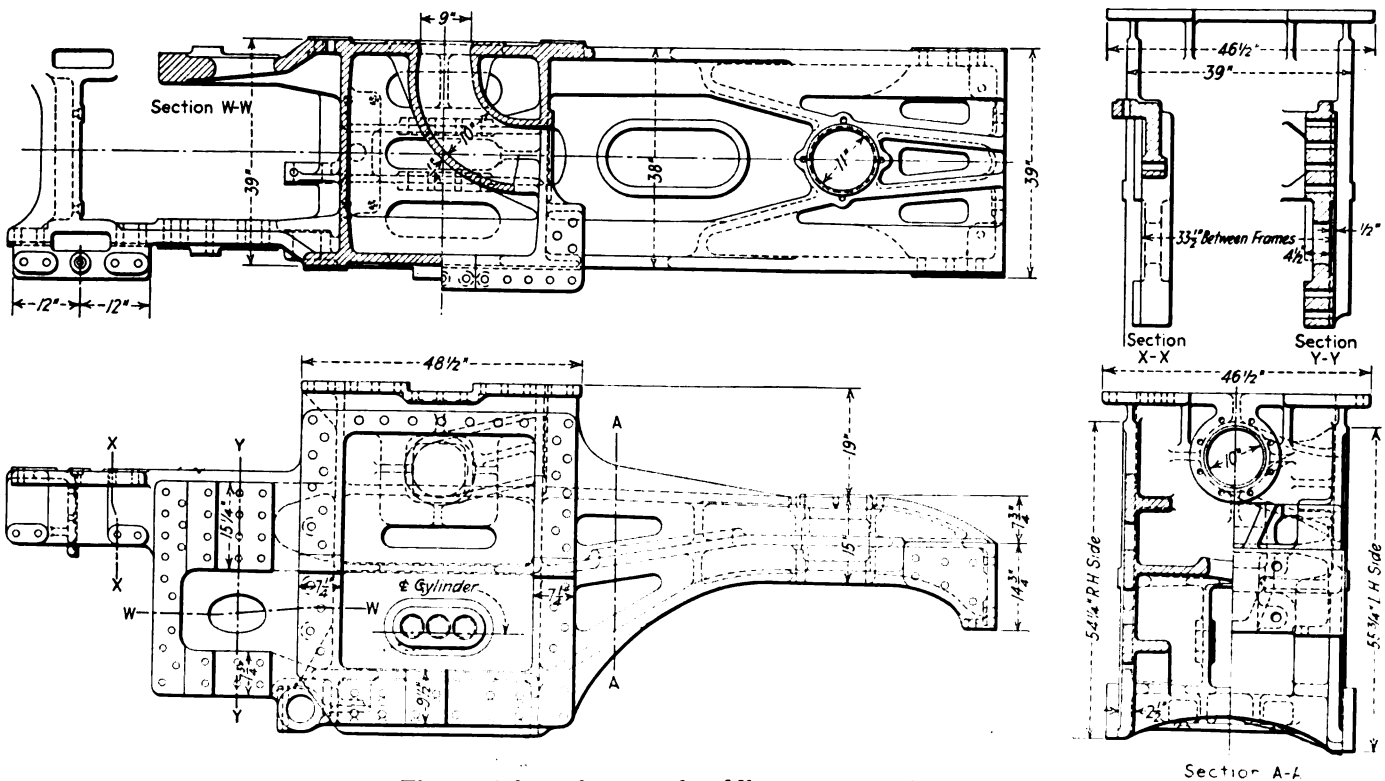
What is expected of the "Horatio Allen"

Probably the outstanding difference in the proportions of the "Horatio Allen" as compared with locomotives of



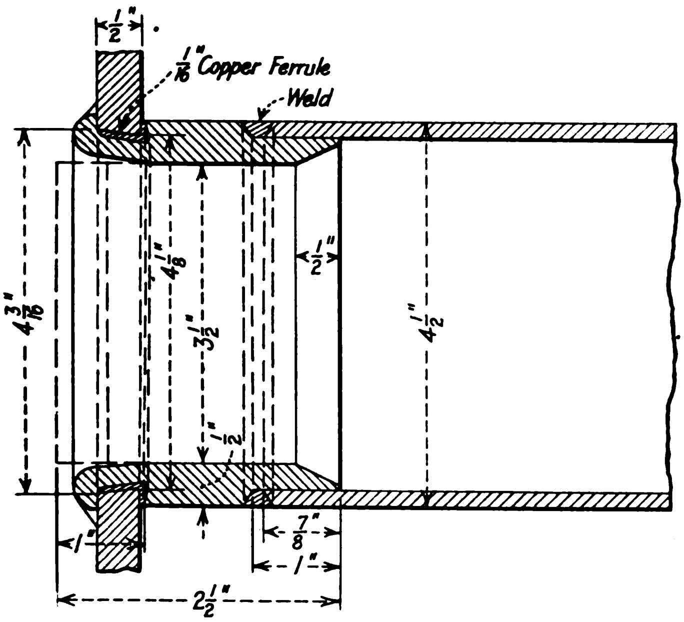
The exhaust nozzle

conventional design will be found in the distribution of the heating surface in the boiler. Out of a total heating surface of 3,200 sq. ft., 1,187 sq. ft., or 37 per cent, is located in the firebox. This is the result of the water-tube



The steel front frame and saddle support casting

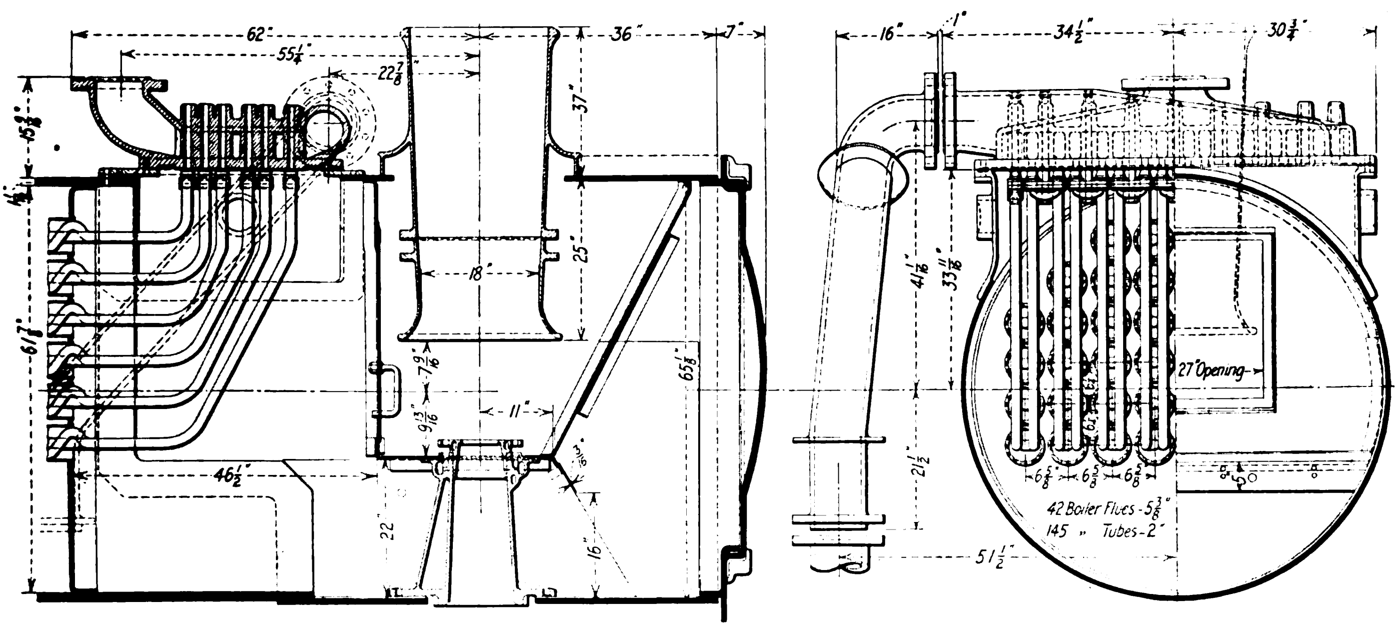
construction. Considering the much greater evaporative value of the firebox heating surface as compared with that of the fire tubes, the capacity of the boiler is much greater than indicated by the total heating surface when compared with the same total amount in a boiler of conventional design, where probably less than 10 per cent of the total would be contained in the firebox. Another factor of interest is the comparatively small amount of superheating surface, the total of which is 579 sq. ft. The purpose in this case, however, was to limit the maximum steam temperature to approximately 600 to 620 deg. F. and this temperature became the controlling factor in the design rather than the amount of superheat. With a boiler pressure of 200 lb. per sq. in., the superheater starts to build up the temperature of the steam from a saturated temperature of 388 deg. F. With the pressure increased to 350 lb., however, the saturated steam temperature is raised to approximately 436 deg. and the amount of heat which can be imparted to the steam within a limit of 620 deg. is correspondingly reduced. Until it is determined what effect will be produced by a combination of high pressures and high temperatures, it was considered safer not to exceed the above maximum temperature.



The Coleman safe end as applied to the superheater flues

The main purpose throughout the design of this locomotive has been to make available the increase in economy and capacity provided by the greater expansion range of pressures considerably higher than those commonly employed. Considering the latent heat of evaporation as a fixed charge which must be distributed over the additional heat applied to build up the pressure to its working point, it is evident that considerable thermal advantage is to be gained by increasing the working pressure and thus decreasing the amount of latent heat which must be charged against each pound of useful pressure. The total heat in one pound weight of steam at 200 lb. pressure, is 1,199 B.t.u., but 1,150 B.t.u. remain in the steam after it has expanded down to atmospheric pressure, a difference of 49 heat units per pound. To raise the steam from 200 to 350 lb. requires a fraction over 7 additional heat units while the expansion range has been increased 75 per cent.

The calculated improvements in economy, which are expected from this design, are 15 per cent less fuel per drawbar horsepower-hour from the increase in pressure; a reduction of 12 per cent in fuel per drawbar horsepower-hour attributable to the boiler, because of the generation of 75 per cent instead of 40 per cent of the steam in the firebox, and the improved circulation in the water-tube type of construction and a reduction of 17 per cent in fuel by compound expansion in the cylinders. This amounts to a combined estimated saving of approximately 39 per cent in the fuel consumption per drawbar horsepower-hour.



The front end arrangement, showing the outside superheater header

The principal dimensions and proportions are as follows:

Table of dimensions, weights and proportions

Builder	American Locomotive Co.
Railroad	Delaware & Hudson
Type of locomotive	2-8-0
Service	Freight

Cylinders, diameter and stroke	23¼ in. by 41 in. by 30 in.
Valve gear, type	Young
Valves, piston type, size	H.P., 12 in.; L.P., 14 in.
Maximum travel	9 in.
Weights in working order:	
On drivers	298,500 lb.
On front truck	49,500 lb.
Total engine	348,000 lb.
Tender	197,800 lb.
Wheel bases:	
Driving	18 ft.
Rigid	18 ft.
Total engine	29 ft.
Total engine and tender	65 ft., 7¾ in.
Wheels, diameter outside tires:	
Driving	57 in.
Front truck	36 in.
Journals, diameter and length:	
Driving, main	12 in. by 14 in.
Driving, others	11 in. by 14 in.
Front truck	7 in. by 15 in.
Boiler:	
Type	Combined water and fire tube
Steam pressure	350 lb.
Fuel, kind	Bituminous and anthracite mixed
Diameter, first ring, inside	61⅞ in.
Firebox, length and width	137 in. by 74⅝ in.
Arch tubes, number and diameter	6—3½ in.
Fire tubes, number and diameter	145—2 in.
Fire flues, number and diameter	42—5⅜ in.
Length over tube sheets	15 ft.
Grate area	71.4 sq. ft.
Heating surfaces:	
Firebox	1,124 sq. ft.
Arch tubes	63 sq. ft.
Tubes	1,132 sq. ft.
Flues	881 sq. ft.
Total evaporative	3,200 sq. ft.
Superheating	579 sq. ft.
Comb. evaporative and superheating	3,779 sq. ft.
Tender:	
Water capacity	9,000 gals.
Fuel capacity	15¼ tons
General data estimated:	
Rated tractive force, simple	84,300 lb
Rated tractive force, compound	70,300 lb.
Booster	19,700 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	86
Weight on drivers ÷ tractive force, simple	3.54
Weight on drivers ÷ tractive force, compound	4.24

Design of the steam locomotive

Discussion of three-cylinder advantages—Vital importance of proper design as a maintenance factor

By J. G. Blunt

Mechanical engineer, American Locomotive Company

As we approach the end of the first hundred years of locomotive service and reflect on the increasing benefits which the reciprocating steam locomotive has given to the transportation problems of today, we are mindful of the seventy-five or more experimental years which preceded it in the making of that historic event. Surely that occasion will, in due time, be celebrated as a reminder of the principles developed during those experimental years, which are the basic ones involved in our locomotive construction today.

In those early years, the problem required a locomotive having the greatest starting power, with means for exerting the maximum tractive force gradually throughout its speed range. The problem today is likewise to produce an individual power unit, possessing this fundamental principle and capable of exerting its full tractive force per unit of weight on each driving axle, while attaining speeds within the limit of safety to human life, the locomotive mechanism and to the right-of-way generally, requiring a minimum of maintenance, with the most economical use of fuel per ton mile hauled.

We have today various means of locomotive power transmission other than the reciprocating steam locomotive, such as electric locomotives using various mechanical and electrical means of transmitting power to the driving wheels, the steam turbine, and various forms of internal combustion engines using gasoline or crude oil which are receiving marked attention, both here and abroad, as sources of locomotive power. Transmitting power from a constant speed motor to the driving wheels, requiring a speed range from nothing to maximum, offers difficult mechanical problems or involves large expenditure in the utilization of electrical transmission.

Various speakers have predicted a decline in the ability and efficiency of the reciprocating steam locomotive to meet the major transportation problems of the future. While these predictions may eventually be confirmed, the fact remains that no locomotive power unit has been produced on a commercially economic basis to cope with the reciprocating steam locomotive in cost of operation per ton mile under average conditions in long distance heavy duty transportation. It, therefore, remains an economic necessity to make the steam locomotive as efficient a power unit as possible until those predictions have reached a degree of commercial utility warranting their general substitution in place of the reciprocating steam locomotive. Many noteworthy efforts have been made, or are now undergoing experimental development, possessing great potential value.

With the foregoing assumption, the problem now is to select that application of the reciprocating principle for the larger steam locomotive units most nearly approaching these commercial requirements and one which will, under varying conditions, deliver the maximum power, speed and economy, at the same time requiring the operation of the fewest number of units to handle the traffic, while transporting the maximum possible trainload over an existing railway line.

The advantages of the three-cylinder type

Thorough investigation has convinced many that the single expansion, three-cylinder application most fully meets these commercial requirements at this time, although future improvements will undoubtedly follow its more or less general use. Efforts, in other ways, are being made and much has been accomplished to utilize higher boiler pressures, devices to provide auxiliary power and great fuel economy, as well as better means for handling the larger power units with greater ease and safety. It readily lends itself to the usual wheel arrangements, with a minimum complication in return for the power produced per locomotive unit having a given driving axle load.

Undoubtedly the most efficient wheel arrangement obtains when connecting the middle cylinder to the crank axle and the outside cylinders to an adjacent axle, thus more evenly distributing the cylinder power throughout the mechanism,

*A paper presented at a meeting of the St. Louis Railway Club, November 14, 1924.

with the least tendency toward slipping or dynamic effect.

In comparing two locomotives with the same wheel arrangement, one having two cylinders and the other three, and assuming equal boiler pressures and driving axle loads, the normal tractive force can be materially improved without increasing the slipping tendency, at the same time increasing the starting power by double the normal tractive force increase. Tests have shown a substantial fuel saving per ton mile hauled, with speed increases, following the better distribution of forces within the mechanism, in combination with the lesser dynamic effects to the rail and roadbed.

In considering locomotives of the sizes required on our trunk lines at this time, no application offers as many practical advantages throughout the speed range as a locomotive equipped with the three-cylinder principle.

It straightens out the tractive force fluctuations for each driving wheel revolution, delivers more tractive force per pound of weight involved and reduces the dynamic effects on the rail. It provides more even power distribution to the mechanical parts, with correspondingly reduced stresses in the locomotive mechanism and right-of-way construction. It eliminates the nosing effects of the inside cylinder entirely, while materially reducing this effect in the outer cylinders by reason of their smaller diameter. It requires less truck lateral resistance, with correspondingly less wear from hub and flange pressure. It enables the steam in the cylinders to be used more expansively through a larger percentage of its running time, while having greater starting ability, accompanied by a substantial fuel saving for tonnage hauled. There is less danger of frame failure on account of the smaller outside cylinders, with less overhanging pressure acting through the rods and axles on the frames. The six exhausts per driving wheel revolution produce a more even draft on the fire, enabling the use of larger exhaust nozzles, with less back pressure in the cylinders, resulting in still greater fuel economy.

Some factors in design

To function best throughout the speed range, a road locomotive should have a leading and a trailing truck to guide it around curves and absorb the lateral vibrations while sliding the driving wheels across the rail when changing the direction of motion from a tangent line through curves, and to absorb the vibration set up by the unbalanced reciprocating forces, as well as those brought about by track irregularities.

The lateral resistance in either truck acts as a long lever arm, extending from the center of one to the center of the other, in absorbing these forces, providing their lateral resistances are operative immediately when moving from their central position and in proportion to the length of wheel base and speed requirements of the locomotive. Under these conditions, the lateral resistance requirement becomes a minimum. With these provisions, hub friction and flange wear are likewise reduced and the frames, frame structure and boiler attachments are subjected to the least detrimental forces.

The spring suspension also has an important bearing on the riding qualities of the locomotive, which becomes increasingly more important in absorbing the rolling tendency as the speed increases. It is fundamental that the load resting thereon should be carried on three independent bearing points, having no connecting equalizations tending to lessen the vertical stability or disturb the even setting of springs and equalizers so linked up. Unmechanical means for correcting or maintaining this stability tend to disturb the individual axle loading.

The relation of design to maintenance

The annual maintenance costs for each freight and passenger locomotive, according to I. C. C. reports for the last four years run around $10,000.* Many causes contribute to these outlays, but I shall discuss them primarily from the viewpoint of the builder.

While operating over irregular track and around curves, the locomotive mechanism is subjected to many complex movements. Where possible of analysis, provision must be made in the design, such that every movement involved is amply provided for in a manner to avoid unknown and incalculable stresses and to relieve bearing surfaces from imperfect surface contact. Failure to provide for them involves excessive wear or fracture and the addition of useless weight. They become, therefore, a fruitful source of increased maintenance. These correct movements must be obtained, however, with a minimum of complication else the cure will be more expensive than the cause. If they are well done, the mechanical efficiency will be increased, along with the mileage, and maintenance costs decreased throughout the life of the locomotive.

Main connecting rods are illustrative of this condition, connected as they are at one end to parts above and oscillating over the spring rigging, while the other is connected to parts below the springs. A degree of universal movement is required in one end relatively to the other, in order that these bearing surfaces may rest uniformly on their respective pins while assuming varying angular positions, which become increasingly more severe as the rod angularity, speed and rolling of the locomotive increase. The angular positions of the rod, together with the maximum angular variations of the axle or pin, unnaturally stress the rods and twist the bearings on their pins, resulting often in heated journals, wasted lubricant, pounding, broken brasses, broken or dislocated rod parts, or failure at the weakest point subject to these unknown stresses. A rolling engine and an uneven track simultaneously centralize unknown stresses in the rods or their connecting parts, the weakest point of which often gives trouble. This involves expensive maintenance which can be corrected only by the use of mechanical construction fully responsive to these movements. Floating bushings have given much relief. Rods constructed as a universal joint offer a naturally correct means for the relief of these abnormal stresses.

Side rod and driving box design

Means to partially relieve coupling rod troubles have been found in the use of floating bushings, while the use of rotative bearings on all but the main connection offers still further relief in providing for the varying angularities of axles, thus eliminating some of the contributing causes for the unknown stresses to which side rods are subjected. These conditions become more pronounced as the size of bearings increases. Surely an automobile or truck would not remain long in service if its power were transmitted in a similar manner.

Driving boxes should undoubtedly be provided with means to prevent the sides from closing in on the journal, due to the reciprocating action of the rods. Supplemental bearings, fitting the axle for a distance below its horizontal center, offer means to minimize the accumulation of longitudinal play in the driving journals, giving substantial relief from the pounding effects in the boxes, which are in turn transmitted to the coupling rods. It may be practical to apply driving box brasses with slight pressure in the box casting if suitably designed, as many are found loose when locomotives come in for repairs. Such an application would relieve the box casting of distortion from the high pressures used when forcing in the journal brasses.

All main journal bearings for engine truck, drivers and trailer, as well as tender, should be provided with means to oil, pack or regrease through non-detachable spring lid covered openings, having means for supplying as free a flow

*See Railway Age for September 9, 1924, page 531.

of clean lubricant to hub surfaces and oil bearing surfaces as possible and well protected from contact with dirt and cinders. Generally speaking, the aim in design should be to require the fewest number of points to lubricate, each of which will supply the need for the greatest length of time and be in the most accessible location. Hub liners securely fastened, easily removable and replacable without dropping wheels may be used to simplify maintenance.

Provision for easy removal and inspection of drawbar pins between engine and tender at engine end, when stoker applications prevent lifting them from above and the booster prevents removing them from below, has been frequently suggested by railway men. Devices using horizontally removable pins have been applied, using double bars equalizing through a circular disc at the tender end. These double bars increase the safety factor between engine and tender and in case one bar or pin fails, the other provides the safety feature while making constant use of both.

The boiler, aside from its pressure stresses and those due to heat expansion, forms the backbone of the locomotive, maintaining the mechanism in alinement. A previous paragraph explains how stresses in the frame fastenings are relieved by absorbing the causes of vibration in the truck resistance mechanism before those stresses reach the frame. The whole frame structure and its attachments to the boiler are thus relieved. If frame attachments to the boiler give trouble, attention should be directed to the truck resistances, because one of the main functions of leading and trailing trucks is to guide the engine and absorb the vibratory actions so destructive at these points.

One of the most destructive forces set up in the locomotive is caused by unrelieved water in the cylinders. Application of effective means to prevent such pressures from exceeding, say 50 lb. above boiler pressure, would assist in preventing the fracture of cylinder heads, forcing the piston or crosshead on the piston rod, carrying the end of the cylinder away or loosening its frame fastenings. Evidently these unrelieved pressures, which at times are destructive, contribute to broken piston rods, connecting rods, axles, frames and other parts subjected thereto, which would largely disappear with the removal or partial removal of the cause. Working steam pressures are the least contributing cause of such trouble.

Center pin bolster bearing trucks, whether of the two-wheel radial or four-wheel center bearing type, should provide for lateral motion devices whose bearing surfaces maintain constant alinement with the axle throughout their range of lateral movement. Otherwise, twisting on the bearing surfaces of these mechanisms, or binding on their bearing surfaces, provide another expensive maintenance cause.

This provision is simply made in the four-wheel center bearing truck by machining the guiding surfaces of the bolster and bolster guide, and in the two-wheel trucks by providing means to maintain the alinement of its top and bottom surfaces relatively to each other throughout their range of lateral movement.

Improved design and construction throughout the locomotive to meet the conditions described, will, in some cases, involve additional first cost, although ingenuity and originality will as often eliminate it. Mindful, however, that destructive causes following incorrect construction are a fruitful source for maintenance expense, some additional outlay at the start would seem well worth while, and I believe the time is coming when the locomotive mechanism will be perfected so as to respond fully to every involved movement capable of analysis. This should always be the objective, for with it go longer individual runs, increased mileage between shoppings, decreased maintenance costs and fewer locomotives to move a given tonnage.

Discussion of locomotive steels*

Heavy modern power requires a better grade of steel—Proper heat treatment essential when repairing alloy steel parts

By Lawford H. Fry

IF the time were not limited it would be interesting to cover the subject fully, following the processes of manufacture from the ore to the locomotive builder's shop. However, we can only touch briefly on the important points. Examination of the various steels entering into locomotive construction shows that they range in composition from one per cent carbon of the springs to less than two-tenths of one per cent of carbon in boiler and structural steels, with several alloy steels included in the forging grades. Recent developments make this group the most interesting to steel treaters.

In order to present the subject logically, let us first analyze the structure of a locomotive. Take as an example the heavy Decapod freight locomotive of the Pennsylvania System. Examination shows that it is made up of three structural units—

(A) The boiler.
(B) The chassis, made up of frames, axles, wheels and springs.
(C) The engines which rotate the wheels.

Let us further dissect these units to ascertain what steels enter into their composition—

(A) The boiler, though large and important, is comparatively simple so far as steel is concerned. The sheets of the barrel and of the inside firebox are of low carbon low tensile steel, the flues and superheater pipes are of similar material, though in some cases charcoal iron flues are used.

(B) The chassis contains a more varied collection of steels; the principal parts classified by the carbon content of the steels used are as follows:
  (a) Carbon about 1.0 per cent, springs.
  (b) Carbon about .75 per cent, tires and rolled steel wheels.
  (c) Carbon about .50 per cent, forgings, such as rods, axles, crank pins, etc.
  (d) Carbon about .25 per cent, castings, such as frames, crossties, driving wheel centers, etc.

(C) The engine adds little to the preceding list of steels, as outside of the cast iron cylinders with which we are not concerned, they are built of forgings and castings similar in composition to those in the chassis.

We are now in a position to group the various steels together and to consider them more in detail. In order to give background to this consideration I offer for comparison one of the first Pennsylvania Consolidation locomotives. The Consolidation locomotive thirty years ago was, as is the Decapod locomotive today, the heaviest standard freight locomotive on the Pennsylvania System. The old Consolidation engine weighed in working order about 126,000 lb., while the modern Decapod locomotive weighs about 386,000 lb. The weight has tripled in thirty years. This great increase in size has brought new problems to the locomotive designer, to the steel

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maker and to the steel treater. Formerly it was sufficient for a draftsman to write *steel* on his drawing of a forging, and no one would raise any question as to specification or heat treatment. Today the designer must choose between a variety of steels and many heat treatments, and his choice must be determined not only by the properties of the steel as it appears in the finished part, but also by the behavior of the steel during the life of the locomotive, by the treatment it must receive during repairs, and by the facilities for such treatment which are available in the railroad repair shops. We shall see this in greater detail in considering the various steels.

Boiler steels

The boiler of the Decapod locomotive weighs without flues about 58,000 lb., and about half as much again with flues and superheater. The largest plate measures 269 in. by 90 in. by 1⅛ in. and weighs 8,550 lb. In the boiler of thirty years ago the largest plate measured 191 in. by 83 in. by 7/16 in. and weighed 1,970 lb. The increase is 60 per cent in area and nearly 200 per cent in weight. So far as material is concerned there has been little change. Boiler plate, then as now, was bought to a specification requiring a tensile strength of 55,000 to 65,000 lb. per sq. in. with approximate ductility requirements. Bend tests are required and nick-and-break tests for homogeneity are now made on firebox plates and on others requiring special flanging. The quality appears to be stabilized and no developments are anticipated in the near future.

Steel castings

The frames are the largest single castings, weighing about 22,000 lb. each and measuring nearly 45 ft. in length. The driving wheel centers account for about another 30,000 lb. and the crossties, frame braces, foot plates, etc., about as much again, say, in round figures, 50 tons of steel castings. This represents a branch of the steel industry which has practically come into existence in the last thirty years and is still developing. Thirty years ago locomotive frames were of wrought iron, driving wheel centers of cast iron and crossties were built up from shapes. The majority of steel castings now used in locomotive work are furnished to a minimum tensile strength of 70,000 lb. per sq. in., but conditions have by no means crystallized. Special designs and special steels are being tried out. There has been a tendency to combine more and more parts into a single casting. Starting with the trailing truck frame and tender truck and tender frames cast in one piece, unification has developed to the point of making a single casting to replace the two locomotive frames and their crossties. This bold experiment is still in the making, but it represents a continuation of development along lines which have already proven satisfactory.

Springs

There has been little development in thirty years, except in size. At present, attention is being given to the question of improvement in springs. To carry out such improvements exact data as to the service being given by locomotive springs are required. If this is accumulated by the railroads and better springs are demanded, steel makers and steel treaters will respond. The large majority of locomotive springs are made of a plain carbon steel having about one per cent of carbon and low silicon and manganese. The steel is quenched from the fitting temperature and removed from the oil which is still so warm that a separate draw is not required. Some railroads are using a steel with from .25 to .50 per cent silicon and a few of the more progressive roads are looking to the use of modern accurate methods of heat treatment.

Tires and rolled steel wheels

The use of rolled steel wheels for engine trucks is a growth of the last twenty years. The steel is of the same general composition as is used for tires with carbon from .60 to .85 per cent. For tires the carbon runs from .55 to .70 per cent for passenger, .60 to .80 per cent for freight, and .70 to .85 per cent for switching service. These are the steels which have been used with practically no change for the last thirty years. Further, there has been no change in tire dimensions. This is the one steel part of a locomotive which shows no change in dimensions or material. Nor is any to be expected. There is little indication of any change being made in the grade of steel used, and there is no possibility of increasing the tire section. This is fixed by well established clearances and rail designs. While locomotive weights have increased three times and the wheel loads two and one half times the tires carrying these loads have remained unchanged. As a consequence, if the tires are to carry the increased loads satisfactorily, great vigilance must be used in maintenance. Shimming should be avoided wherever possible, and when unavoidable new steel of known and uniform thickness should be used. Shims should be applied in as few pieces as possible without overlaps and without gaps. Tires should not be removed from wheel centers for turning. The heavy modern wheel loads cause a certain amount of distortion of tire and wheel center so that the removal of a tire and reapplication in a different position leave part of the tire unsupported. Further distortion follows naturally, and failure may result.

Forgings

As has already been pointed out, we find here a greater variety of steels and of heat treatments than in any of the other steel parts. Let us first dispose of the smaller forgings such as valve motion parts. As it is desirable to have lighter moving parts, some railroads have taken advantage of specially made and treated steels. Good results can be obtained thus, but such parts must not be heated in repairing. Eccentric rods which may require heating for setting to length in construction or repair should be of a comparatively low carbon, say not over .40 per cent without alloys.

For the main locomotive forgings such as driving axles, main and side rods, and crank pins, the following steels will be found in current use:

- Plain carbon steel.
  - Carbon about .45 to .50 per cent. Such steel is to be used annealed or quenched and tempered, or even, in the case of parts made in railroad shop, unannealed.
- Chrome nickel steel.
  - Quenched and tempered.
- Chrome vanadium steel.
  - Quenched and tempered.
- Carbon vanadium.
  - Steel normalized.

Of these the quenched and tempered alloy steels with an elastic limit of 65,000 lb. per sq. in. and a tensile strength of 110,000 to 125,000 lb. per sq. in. give the greatest strength per unit of weight. They have the disadvantages of high first cost, difficulty in machining, and the necessity for care in maintenance to avoid heating which would remove the desirable properties given by the original heat treatment.

Standing next in point of strength is the normalized carbon vanadium steel with a yield point of 62,000 lb. per sq. in. and a tensile strength of about 100,000 lb. per sq. in. This steel owes its strength to a manganese content of about .90 per cent, the vanadium serving to ensure ductility on normalizing. The heat treatment usually consists in heating to about 1,600 deg. F. and cooling in air

(normalizing) followed by a reheating to about 1,150 deg. F. This steel compared with the quenched and tempered steels has the advantage of not having been subjected to the severe internal strain of quenching, and also does not lose so much of its strength on being reheated in repairs.

Quenched and tempered carbon steel with an elastic limit of 50,000 to 55,000 lb. per sq. in. and a tensile strength of about 90,000 lb. per sq. in. stands close to carbon vanadium steel in strength. It loses more of its strength on being reheated.

In using the quenched or tempered steels or normalized carbon vanadium steel for round forgings, such as axles or crank pins, it is of great advantage to bore a hole of ample diameter along the longitudinal axis. It is recommended that the diameter of the hole be approximately half the outside diameter of the forging. This has the advantage of reducing the thickness of metal through which heat must penetrate during treatment. In a bored forging, heating and cooling take place in the bore as well as from the outside, and in the case of quenched forgings this is of great importance in reducing the internal strains set up during quenching. Large forgings when bored respond more readily to heat treatment and better physical properties can be obtained. Even apart from this, boring is advantageous in giving greater strength per unit of weight. With two forgings of the same material and of the same weight the bored forging can be made about fifteen per cent stronger than the solid.

Last but not least come the annealed firebox steel forgings. These make up the majority of locomotive forgings. Annealed carbon steel is simple to make and simple to handle, and is to be preferred except under special conditions in which higher tensile strength is necessary. Though the annealed plain carbon steel forgings are the simplest to make, it must be remembered that with these as with all other forgings it is essential to have sound well-made steel to start with if satisfactory results are to be secured. Also correct and accurate control of annealing temperatures is desirable.

Locomotive and motor car orders in 1924

A number of developments of previous years have progressed sufficiently to be incorporated into new power

A TOTAL of 1,413 locomotives were ordered for domestic service in the United States during 1924. This total compared with 1,944 in 1923, and with 2,600 in 1922, and represents an amount of business much below the average. Since 1901 there have been but four years, other than 1924, in which domestic locomotive purchases have failed to exceed even such a small total as 1,500.

The information given in Table I shows that the orders placed by railroads in Canada with Canadian builders totaled 71, comparing with 82 in 1923, and with 68 in 1922. The National Railways of Mexico were heavy purchasers of equipment in United States markets; their buying included 50 locomotives, as well as large numbers of cars. Other export business, outside of the Mexican purchases, totaled 92 locomotives.

Table I—Orders for locomotives since 1915

Year	Domestic	Canadian	Export	Total
1915	1,612	....	850	2,462
1916	2,910	....	2,983	5,893
1917	2,704	....	3,438	6,142
1918	2,593	209	2,086	4,888
1919	214	58	939	1,170
1920	1,998	189	718	2,905
1921	239	35	546	820
1922	2,600	68	131	2,799
1923	1,944	82	116	2,142
1924	1,413	71	142	1,626

The number of locomotives built for domestic service—in contradistinction to new business taken as shown in the totals for orders—was 1,726. This compared with 3,362 in 1923, and, as in the case with orders, was considerably below average.

The Car Service Division reports each month the number of locomotives installed and retired on the Class I roads. For the year 1923 these reports showed that there were installed 4,037 locomotives, and that there were retired 3,672. The latest report from 1924 to date is that for November. In the first eleven months of 1924, installations totaled 1,951—indicating a figure for the year less than half the total for 1923—while retirements for the eleven months totaled 1,844.

In no month during the past year was locomotive buying particularly heavy. The best month of the year was March, in which month orders for 283 locomotives were reported, and the next best was October, in which month orders totaled 135. Orders in June totaled one only, and in August only eight.

Table II—Important locomotive orders in 1924

	0-6-0	0-8-2	2-8-0	2-8-2	2-10-2	Mallet	4-6-0	4-6-2	4-8-2	4-10-2
A. T. & S. F.	..	..	..	26	15	..	..	10	6	..
A. C. L.	5	..	..	..	..	..	..	20	..	..
B. & A.	4	..	..	..	..	..	..	5	..	..
Can. Nat.	..	..	..	20	5	..	..	..	21	..
Can. Pac.	..	..	..	15	..	..	..	..	..	..
C. of Ga.	.	..	..	10	..	..	..	..	..	..
C. of N. J.	..	..	..	20	..	..	..	..	..	..
C. & O.	..	..	..	100	..	..	..	..	..	..
C. R. I. & P.	..	..	..	..	..	..	..	1	10	..
C. C. C. & St. L.	20	..	..	25	..	..	..	5	..	..
Fla. E. C.	11	..	..	..	..	..	..	..	32	..
G. T. (in U. S.)	15	..	..	..	..	..	..	..	..	..
I. C.	..	..	..	25	..	..	..	..	25	..
I. H. B.	..	5	..	5	..	..	..	..	..	..
L. A. & S. L.	..	..	..	..	10	..	..	..	5	..
L. & N.	14	..	..	34	..	..	..	6	..	..
Me. C.	..	..	..	6	..	..	..	2	..	..
M. C.	10	..	..	15	..	..	..	5	..	..
M. K. T.	10	..	..	..	..	..	..	..	..	..
M. P.	20	..	..	60	..	..	..	20	..	..
Nat. Rys. of Mex.	..	..	25	10	..	..	10	4	..	..
N. Y. C.	50	..	..	50	..	..	..	..	..	..
N. Y. C. & St. L.	10	..	..	10	..	..	..	..	..	..
N. Y. N. H. & H.	10	..	..	..	..	..	..	..	..	..
Pennsylvania	50	..	..	..	..	..	50	50	..	..
T. & I. E.	..	..	..	11	..	..	..	..	..	..
P. & R.	5	..	25	..	..	..	..	10	..	..
S. A. L.	..	..	..	30	..	..	..	..	..	..
So.	30	..	..	25	..	5	..	15	..	..
S. P.	..	..	..	..	1	..	..	..	..	16
Term. R. R. of St. L.	15	..	..	..	..	..	..	..	..	..
U. P.	..	..	..	..	..	20	..	..	..	..
Wabash	1	..	..	50	..	..	..	..	..	..
W. P.	..	..	..	5	..	5	..	..	..	..

The railways handled in October the largest amount of

business, gaged by net ton-miles, that they ever handled in a similar period of time. On December 1 there were on hand 4,904 locomotives stored in serviceable condition, thereby indicating the results of the buying program of 1922, followed by the ambitious repair program of 1923, as well as the results of better locomotive utilization. This may be the explanation of the failure of locomotive purchases in 1924 to be commensurate with the volume of other railway purchases. Possibly the balance will be restored in 1925, and resort had to purchases of new power needed now less to increase merely the total amount of tractive effort, but desired rather because of the possibility of securing more effective motive power units in place of much of the older and less efficient power still remaining in service.

Table III—Types of locomotives ordered in 1924

Type	Railroad	Industrial	Export	Total
0-4-0	0	3	0	3
0-6-0	13	34	4	51
0-6-2	2	0	0	2
0-8-0	295	2	0	297
0-8-2	5	0	0	5
0-10-0	1	0	0	1
2-6-0	3	4	11	18
2-6-2	5	10	0	15
2-8-0	61	1	4	66
2-8-2	582	12	50	644
2-10-0	3	0	0	3
2-10-2	31	0	1	32
Mallet	34	4	1	39
4-4-0	7	0	0	7
4-6-0	69	0	0	69
4-6-2	167	0	4	171
4-8-0	3	0	0	3
4-8-2	113	0	4	117
4-10-2	16	0	0	16
Miscellaneous	0	6	2	8
Geared	0	16	1	17
Forney	1	3	0	4
Shay	1	3	0	4
Electric	24	0	10	34
Total	1,436	98	92	1,626

Table IV—Three-cylinder locomotives ordered in 1924

Road	No.	Weight Lb.	Cylinders, in.	Type	Service
Chicago, Rock Is. & Pacific	1	305,000	22½ x 28	4-6-2	Pass.
Delaware, Lacka. & Western	2	392,000	25 x 28	4-8-2	Pass.
Lehigh Valley	6	369,000	25 x 28	4-8-2	Frt. & Pass.
Louisville & Nashville	1	334,000	23 x 28 & 32	2-8-2	Frt.
Missouri Pacific	1	302,500	22½ x 28	4-6-2	Pass.
Missouri Pacific	1	334,000	23 x 28 & 32	2-8-2	Frt.
N. Y., N. H. & Hartford	10	245,000	22 x 28	0-8-0	Sw.
Southern Pacific	16	438,000	25 x 28 & 32	4-10-2	———
Wabash	5	351,000	23 x 28 & 32	2-8-2	Frt.

During the year which has just closed, the total capital expenditures authorized by the Class I railroads of the United States amounted to $1,077,297,000. Of this amount $101,233,000, or 9.4 per cent of the total authorized expenditures, was for locomotives. In 1923, 19.75 per cent of the total expenditures were for locomotives.

Types of locomotives ordered

A summary of the more important orders, grouped according to roads and types, placed in 1924, will be found in Table II. This list includes 1,286 locomotives for 34 railroads or 79 per cent of the locomotives ordered by the American, Canadian and Mexican roads. The balance was in small orders from a number of railroads.

Table III shows the types of locomotives which were ordered for the railroads, industrial concerns and for export. Similar information for the preceding year will be found on page 77 of the February, 1924, issue of the *Railway Mechanical Engineer*.

It will be observed that of the 1,436 locomotives ordered by the railroads in 1924, 316 or 21 per cent were for switching service. The preponderance of the orders were for the 0-8-0 type, for which there were 295. The largest orders for switch engines were those placed by the New York Central and the Pennsylvania for 50 each of the 0-8-0 type. An interesting phase of last year's purchasing was the comparatively few orders placed for the 0-6-0 type.

Locomotives with two-wheel leading and three, four or five pairs of drivers, totaled 685 or 47.7 per cent of the railroad orders. In this group, 582, or 40.5 per cent, were of the 2-8-2 type. Roads which placed orders for at least 25 locomotives of the 2-8-2 type were the Atchison, Topeka & Santa Fe; Canadian National; Chesapeake & Ohio; Cleveland, Cincinnati, Chicago & St. Louis; Illinois Central; Louisville & Nashville; Missouri Pacific; National Railways of Mexico; New York Central; Seaboard Air Line; Southern and the Wabash. Of the 61 orders for the 2-8-0 type 25 were for the Philadelphia & Reading and 25 were for the National Railways of Mexico. It will be recalled that the Philadelphia & Reading ordered 25 of the same type in 1923. Orders for the 2-10-2 include 15 for the Atchison, Topeka & Santa Fe and 10 for the Los Angeles & Salt Lake.

There were 34 Mallet locomotives ordered in 1924 or 19 less than the number ordered in 1923. The largest order placed for this type in 1924 was 20 for the U. P.

A total of 405 locomotives of the type usually employed in express and passenger service were ordered last year; this was 20.8 per cent of the total of all orders. Of these, 167 were of the 4-6-2 type, 113 were of the 4-8-2 type and 69 were of the 4-6-0 type. The largest order for the 4-6-2 type was for 50 placed by the Pennsylvania, which also ordered 50 of the 4-6-0 type. Orders for 20 of the 4-6-2 type were placed by the Atlantic Coast Line and the Missouri Pacific.

Table V—Principal orders for 2-8-2 locomotives in 1924

Road	No.	Weight, lb.	Cylinders, in
Chesapeake & Ohio	50	358,000	28 x 30
Atchison, Topeka & Santa Fe	26	343,200	27 x 32
New York Central	50	337,000	28 x 30
Pittsburgh & Lake Erie	11	337,000	28 x 30
Michigan Central	15	334,500	28 x 30
Cleveland, Cincinnati, Chicago & St. L.	25	334,500	28 x 30
Louisville & Nashville	1	334,000	23 x 28 & 32*
Missouri Pacific	1	334,000	23 x 28 & 32*
Wabash	20	329,000	27 x 32
Southern	25	326,000	27 x 32
Canadian National	20	324,600	27 x 30
Canadian Pacific	15	321,400	25½ x 32
Seaboard Air Line	10	320,900	27 x 28
Louisville & Nashville	17	320,000	27 x 32
New York, Chicago & St. Louis	10	317,500	26 x 30
Central of Georgia	10	300,500	27 x 30
Illinois Central	25	309,500	27 x 30
National Railways of Mexico	10	262,260	25 x 30

* 3 cylinder.

Table VI—Principal orders for 0-8-0 locomotives in 1924

Road	No.	Weight, lb.	Cylinders, in.
Pennsylvania	50	275,000	27 x 30
Missouri, Kansas, Texas	10	248,000	26 x 26
Terminal Railroad of St. Louis	15	248,000	26 x 28
New York, New Haven & Hartford	10	245,000	22 x 28*
Missouri Pacific	5	224,490	25 x 28
Michigan Central	5	223,500	25 x 28
New York Central	50	219,000	25 x 28
Louisville & Nashville	8	217,000	25 x 28
Cleveland, Cincinnati, Chic. & St. Louis	20	216,500	25 x 28
New York, Chicago & St. Louis	10	216,500	25 x 28
Florida East Coast	11	215,000	25 x 28
Southern	30	214,000	25 x 28
Grand Trunk (in U. S.)	15	211,000	22 x 28

* 3 cylinder.

The 4-10-2 type, of which 16 were ordered by the Southern Pacific, is the first of this wheel arrangement. They are of the three-cylinder design, having a tractive force of 76,900 lb., not including the booster, and a weight of 306,000 lb. on the drivers.

Three-cylinder locomotive and high-pressure 2-8-0 of the D. & H. are the outstanding developments

Without doubt, the three-cylinder simple locomotive is the outstanding development for the past year. Table IV shows a total of 43 three-cylinder locomotives ordered in 1924. These locomotives are distributed among nine roads, 16 of the 4-10-2 type being ordered by the Southern Pacific and 10 of the 0-8-0 type by the New Haven.

The most striking motive power development which has

culminated within the past year is the Muhlfeld high-pressure, cross-compound 2-8-0 type locomotive of the Delaware & Hudson. This locomotive carries a working boiler pressure of 350 lb. and is rated at over 80,000 lb. tractive force, simple, and over 100,000 lb. with the tender booster in operation. The most apparent limitation of this locomotive is the unusually heavy load carried on the drivers which averages approximately 74,600 lb. per pair of drivers.

Tendencies as to size

An idea of the size of locomotives required to meet present-day operating conditions may be obtained by referring to Tables V to VIII inclusive, in which important orders for the leading types ordered in 1924 are grouped according to weight. Similar information for the 2-8-2, 2-10-2, 4-6-2 and 4-8-2 types of locomotives ordered in 1923 will be found on pages 77 and 78 of the February, 1924, issue of the *Railway Mechanical Engineer.*

Table VII—Principal orders for 4-6-2 locomotives in 1924

Road	No.	Weight, lb.	Cylinders, in.
Atchison, Topeka & Santa Fe	10	312,000	25 x 28
Pennsylvania	50	308,890	27 x 28
Chicago, Rock Island & Pacific	1	305,000	22½ x 28*
Missouri Pacific	1	302,500	22½ x 28*
Southern	15	299,000	27 x 28
Atlantic Coast Line	20	280,610	25 x 28
Louisville & Nashville	6	277,000	25 x 28
Philadelphia & Reading	10	273,600	25 x 28

* 3 cylinder.

Table VIII—Principal orders for 4-8-2 locomotives in 1924

Road	No.	Weight, lb.	Cylinders, in.
Illinois Central	25	362,500	28 x 28
Atchison, Topeka & Santa Fe	6	361,600	28 x 28
Los Angeles & Salt Lake	5	340,000	29 x 28
Canadian National	15	339,950	26 x 30
Florida East Coast	32	308,000	26 x 28

Of the 2-8-2 type, see Table IV, 12 of those listed are of the three-cylinder design. These locomotives stand fifth from the top of the list with weights of 334,000 lb. Both the Missouri Pacific and the Louisville & Nashville three-cylinder locomotives have the same size cylinders, 23 in. by 28 in. and 32 in. The 30 locomotives ordered by the Chesapeake & Ohio are exceptionally heavy. They weigh 350,000 lb. and have 20 in. by 30 in. cylinders. These locomotives are slightly heavier than those of the same type ordered in 1923 by the Delaware, Lackawanna & Western, which weighed 356,500 lb. and had 28 in. by 32 in. cylinders.

The order of 10 three-cylinder locomotives of the 0-8-0 type by the New York, New Haven & Hartford, shown in Table VI, is the only order for three-cylinder locomotives designed for switching service. These locomotives weigh 245,000 lb. and have 22 in. by 28 in. cylinders. The largest orders of the 0-8-0 type were the 50 ordered by the New York Central and an order for the same number placed by the Pennsylvania.

Table VII includes eight railroads and 113 of the 167 locomotives of the 4-6-2 type ordered in 1924. It will be noted that two 4-6-2 type locomotives of three-cylinder design ordered by the Missouri Pacific and the Chicago, Rock Island & Pacific have been included in this list. Table VIII includes five railroads and 93 of the 113 locomotives of the 4-8-2 type ordered. The Canadian National also ordered 6 locomotives weighing 339,000 lb. each, which are not included in this table. Of the 4-6-2 type locomotives, 72, or 43 per cent, weighed 300,000 lb. or over. Of the 4-8-2 type locomotives, 55, or 48.6 per cent, weighed over 350,000 lb. and none weighed less than 308,000 lb.

Comments on designs

Considerable may be learned from the tabulations as to the general type and size of locomotives that are being purchased. The eight-wheel type seems to be the most popular for switching service. The large number of orders placed for the 2-8-2 show that this type is still the general standard for freight traffic with a tendency for heavier models. The ordering of 10 three-cylinder locomotives of the 0-8-0 type by the New York, New Haven & Hartford is perhaps, with the exception of the "Horatio Ollen" ordered by the Delaware & Hudson, the most striking feature in the year's developments.

The popularity of the Mallet for heavy freight service

Table IX—Important motor equipment orders in 1924

Road	No.	Type	Length	Horsepower	Seating capacity	Weight	Builder
American R. R. of Porto Rico	3	Coach	57 ft. 0 in.	...	46	33,141	Wason Mfg. Co.
Boston & Maine	1	Motor	43 ft. 6 in.	70	38	29,000	J. G. Brill Co.
	1	Motor	51 ft. 2¾ in.	225	30	40,000	Sykes.
	1	Trailer	45 ft. 5½ in.	...	52	27,000	Sykes.
Canadian National	2	Storage battery	....	...	..	......	Int. Equip.
	2	Diesel electric	Equipments only	...	..	......	Westinghouse Electric.
Chicago, Burlington & Quincy	3	Motor	43 ft. 0 in.	60	41	41,600	Edwards.
Chicago, Great Western	2	Motor	44 ft. 7 in.	245	30	30,000	Sykes.
	2	Trailer	39 ft. 4 in.	...	44	21,000	Sykes.
Clev., Cinn., Chic. & St. Louis	4	Motor	35 ft. 0 in.	225	..	......	Sykes.
	4	Trailer	28 ft. 0 in.	...	60	......	Sykes.
	1	Motor	35 ft. 0 in.	150	..	......	Sykes.
Erie	7	Motor	43 ft. 6 in.	70	38	29,000	J. G. Brill Co.
	2	Motor	55 ft. 0 in.	250	50	50,000	J. G. Brill Co.
International Gt. Northern	2	Motor	42 ft. 7 in.	68	47	32,000	J. G. Brill Co.
	1	Motor B. & M.	42 ft. 7 in.	68	..	31,000	J. G. Brill Co.
	1	Trailer	42 ft. 7 in.	..	54	29,000	J. G. Brill Co.
Jonesboro, Lake City & Eastern	1	Gas-elec.	60 ft. 0 in.	175	50	96,000	General Electric.
	1	Gas-elec.	70 ft. 0 in.	175	91	96,000	General Electric.
Missouri Pacific	3	Motor	43 ft. 6 in.	70	38	29,000	J. G. Brill Co.
Morrissey, Fernie & Michel	1	Motor	32 ft. 0 in.	75	30	19,000	Edwards.
	1	Trailer	32 ft. 0 in.	..	34	15,000	Edwards.
	1	Motor	43 ft. 0 in.	100	50	41,000	Edwards.
New Orleans & Lower Coast	1	Motor	40 ft. 0 in.	90	36	26,000	F. W. D. Auto Co.
	2	Trailer	40 ft. 0 in.	...	40	22,000	F. W. D. Auto Co.
New York Central	1	Motor	55 ft. 0 in.	250	50	50,000	J. G. Brill Co.
	1	Motor	55 ft. 0 in.	150-200	..	55,000	J. G. Brill Co.
	1	Trailer	50 ft. 0 in.	...	60	30,000	J. G. Brill Co.
N. Y., N. H. & H.	10	Motor	42 ft. 7 in.	150	45	35,000	Sykes.
	10	Motor	42 ft. 0 in.	150	45	34,000	J. G. Brill Co.
	1	Gas-elec.	62 ft. 2 in.	250	65	70,600	J. G. Brill Co.
Northern Pacific	1	Gas-elec.	59 ft. 4 in.	175	59	78,400	Electro-Motive Co.
	1	Motor	58 ft. 10 in.	104	33	73,000	Oneida Mfg. Co.
	3	Gas-elec.	59 ft. 4 in.	175	58	78,400	Electro-Motive Co.
Pennsylvania	1	Motor	43 ft. 6 in.	70	38	30,000	J. G. Brill Co.
	2	Motor	44 ft. 5 in.	150	38	34,000	J. G. Brill Co.
	1	Trailer	18 ft. 6 in.	...	..	5,000	J. G. Brill Co.
Wichita Falls & Southern	1	Motor	43 ft. 6 in.	70	38	29,000	J. G. Brill Co.
	1	Motor-bagg.	55 ft. 0 in.	250	..	50,000	J. G. Brill Co.
	1	Trailer	55 ft. 0 in.	...	60	30,000	J. G. Brill Co.
Wilmington, Brunswick & Southern	1	Motor	32 ft. 0 in.	75	28	19,000	Edwards.
	1	Trailer	34 ft. 0 in.	...	40	16,000	Edwards.
	1	Frt. trailer	25 ft. 0 in.	...	..	12,500	Edwards.

appears to be on the decrease. In 1922 the orders for articulated locomotives amounted to 116. In 1923 the total number ordered by the railroads fell to 53 and only 34 articulated locomotives were ordered in 1924, of which 20 were ordered by the Union Pacific.

The Pacific, or 4-6-2 type, is evidently considered to be the best suited for ordinary passenger traffic if the large number ordered in 1924 may be taken as an indication. Seventy-three of the 167 locomotives of this type ordered weighed over 300,000 lb. The popularity of the Mountain, or 4-8-2 type, appears also to be in the ascendency, the orders placed in 1924 totaling 113. This type of locomotive has evidently found its place not only where long and heavy passenger trains have to be hauled in territory where grades are an important factor, but also for hauling fast freight.

Among the year's developments in this country that are also worthy of special mention are the oil-electric locomotives and the tendency towards locomotive tenders of large capacity. A recent order for fifty 15,000-gal. tenders for the New York Central is an example of the latter trend in equipment design.

The General Electric Company and the Ingersoll-Rand Company have built jointly an oil-electric switching locomotive which embodies the combination of a six-cylinder solid injection type oil engine and a direct current generator driving four motors without intervening accelerating resistances. This has resulted in a remarkably flexible and economical form of motive power, which if experience proves its practicability when adapted to units of greater hauling capacity, should materially aid in the efforts being made to utilize the oil engine with its low operating cost for the propulsion of railway locomotives.

Use of motor cars for handling light traffic increasing

The domestic orders placed in 1924 for rail motor cars amounted to 120. These cars are estimated to have a total value of $2,250,000. A total of 10 rail motor cars, including the two Diesel-electric equipments ordered from the Westinghouse Electric Company by the Canadian National, and two trailers were ordered by various Canadian roads. Among the important motor equipment orders shown in Table IX are the orders for 21 motor cars placed by the New York, New Haven & Hartford and for nine placed by the Erie. It will be noted from the list of types shown in Table X, that there is considerable variation in weight and horsepower not only between the cars built by different manufacturers but by the same manufacturer as well. The lengths of the various types of motor cars run from as low as 32 ft. to as high as the 70-ft. cars built by the General Electric Company for the Jonesboro, Lake City & Easton.

The tendency in design continues toward the development of cars with a larger power reserve. This is a natural trend because it is not economical to require a gasoline engine to run continuously at high points on the horsepower curve, for an overloaded engine requires frequent repairs which result in high maintenance costs. Among the various auxiliaries on rail motor cars, the lighting arrangement has given the most trouble. Storage batteries for lighting purposes have not given entirely satisfactory results and independent lighting equipment is coming into use. The possibility of the application of axle lighting equipment to rail motor cars has received some consideration, but this is still a problem for the future.

The present tendency is toward lightening of the superstructure and increasing the ruggedness of the trucks. The past year has seen an effort to conserve floor space by placing the power units under the floor of the car. This seems to be a step in the right direction as floor space is an important factor in cars of this type, in which the weight limitations are necessarily severely restricted.

Table X—Types of motor equipment ordered in 1924

Builder	No.	Type	Horse Power	Weight	Length	Seating Capacity
J. G. Brill Co.	24	motor	70	29,000	43 ft. 6 in.	38
	7	motor	250	50,000	55 ft. 0 in.	50
	1	trailer	...	24,000	34 ft. 0 in.	36
	2	motor	68	32,000	42 ft. 7 in.	47
	1	motor B. & M.	68	31,000	42 ft. 7 in.	..
	2	trailer	..	29,000	42 ft. 7 in.	54
	2	trailer	..	30,000	50 ft. 0 in.	60
	1	motor	150-200	55,000	55 ft. 0 in.	..
	10	motor	150	34,000	42 ft. 0 in.	45
	2	gas.-elec.	250	70,000	62 ft. 2 in.	65
	2	motor	150	34,000	44 ft. 5 in.	38
	1	trailer	..	5,000	18 ft. 6 in.	..
	1	trailer	..	30,000	55 ft. 0 in.	60
Calif. Body Bldg. Co.	1	motor	80	16,400	33 ft. 0 in.	33
Edwards	9	motor	75	19,000	32 ft. 0 in.	30
	3	motor	75	20,000	34 ft. 0 in.	40
	3	motor	60	41,600	43 ft. 0 in.	41
	1	motor	206	48,000	51 ft. 0 in.	50
	2	trailer	..	16,000	34 ft. 0 in.	40
	1	frt. trailer	..	12,500	25 ft. 0 in.	..
	1	motor	100	41,000	43 ft. 0 in.	50
	1	trailer	..	15,000	32 ft. 0 in.	34
Electro-Motive Co.	4	gas.-elect.	175	78,400	59 ft. 4 in.	58
F. W. D. Auto Co.	1	motor	90	26,000	40 ft. 0 in.	36
	2	trailer	..	22,000	40 ft. 0 in.	40
Ford	1	motor	..	6,000	24 ft. 0 in.	20
General Electric	1	gas.-elect.	175	96,000	60 ft. 0 in.	50
	1	gas.-elect.	175	96,000	70 ft. 0 in.	91
International Equip.	2	storage battery	..	.....	....	..
	1	storage battery coach	..	71,200	52 ft. 3 in.	50
International Motor Co.	1	motor	60	22,500	37 ft. 7⅜ in.	41
	1	motor	120	48,000	54 ft. 0 in.	44
Oneida Mfg. Co.	1	motor	208	66,000	70 ft. 0 in.	32
	2	motor	140	67,000	70 ft. 0 in.	62
	1	motor	140	65,000	68 ft. 0 in.	38
	1	motor	104	73,000	58 ft. 10 in.	33
	1	motor	45	7,500	14 ft. 0 in.	14
Ry. Storage Battery Car	2	pass. & bagg.	..	.....	55 ft. 0 in.	..
Sykes	1	motor	225	40,000	51 ft. 2¾ in.	30
	1	trailer	..	27,000	45 ft. 5½ in.	52
	2	motor	245	30,000	44 ft. 7 in.	30
	2	trailer	..	21,000	39 ft. 4 in.	44
	4	motor	225	.....	35 ft. 0 in.	..
	1	motor	150	.....	35 ft. 0 in.	..
	2	trailer	..	.....	28 ft. 0 in.	60
	2	trailer	..	.....	28 ft. 0 in.	..
	10	motor	150	35,000	42 ft. 7 in.	45
	1	motor	150	24,000	41 ft. 10 in.	38
Wason Mfg. Co.	3	coaches	..	33,141	57 ft. 0 in.	46
Westinghouse Electric	2	Diesel-Elec	..	.....	equipment only	..

Fuel economy at power plants on the S. P.

THE Southern Pacific has for many years made strenuous efforts to reduce its fuel consumption in train service with the result that it is in the first rank among railroads of this country with respect to its fuel record. In the latter part of 1923 attention was also called to the possibility of savings in fuel at stationary boiler plants with the result that a fuel committee was formed on the Texas Lines, consisting of the superintendent of motive power, the chief engineer and the engineer of fuel and water service. A competent assistant engineer was employed and a systematic plan devised for the thorough and periodical inspection of all boiler plants; with recommendations for changes in installations, which were studied and passed on by the fuel committee at monthly meetings, and the systematic instruction of boiler plant employees in the operation of the plants.

On the Texas and Louisiana Lines of the Southern Pacific there are 94 stationary boiler plants of various sizes and uses, varying from large plants at shops and terminals to small plants at water and oil stations, etc. All of these plants burn crude oil as fuel and the total cost of the oil consumed in 1923 was over $600,000.

How the H. & T. C. power plant was improved

The H. & T. C. power plant, before recent improvements were made, consisted of one 120-hp. Heine water tube boiler and two 160-hp. Erie City horizontal water-tube boilers, all set singly, their uptakes being connected into a breeching leading to one brick stack 100 ft. high. These boilers supplied steam to operate two 12-in. by 8½-in. by 12-in. duplex Union Steam Pump Company's pumps, used for washing and filling engines, two 12-in. by 10-in. by 12-in. duplex Worthington water pumps for pumping water from sump to stand pipe, one Knowles 14-in. by 7¼-in. by 12-in. Underwriter's fire pump, two 7½-in. by 5-in. by 6-in. duplex Worthington boiler feed pumps, one 500-cu. ft. duplex steam-driven air compressor, one 18-in. by 24-in. simple steam engine for driving machine shop tools and five oil pumps.

During the summer, after a majority of the improvements had been completed and the fuel consumption had been reduced about 40 per cent, it was found that the load could be carried by one boiler. One boiler supplied all steam necessary until the sleet storm on December 19. This operation of one boiler resulted in further fuel savings by firing one boiler at full load in place of two boilers at less than rating and by eliminating large radiation losses from the second boiler. It also provided a large margin of reserve.

Comparative requirements for steam

The requirements for steam during 1923 and 1924 were approximately the same. The same principal equipment was in service such as compressors, engines, water and oil pumps. During 1924, there was put into operation a hot water washing and filling system which replaced one small pump using cold water with two larger pumps for handling hot water. There was also installed an auxiliary oil tank for the power plant with two small oil pumps for pumping oil direct to the burners. The oil pump which formerly pumped oil to the burners through about 800 ft. of two-inch line at a pressure of 240 lb. per sq. in. now pumps oil through a three-inch line to the auxiliary tank.

The following is an itemized statement of the improvements made and the cost of each:

Installation of 2-in. line to waste-reclaiming plant to use exhaust in place of live steam	$90
Connections from hot water washing and filling tank to boiler feed pumps	150
Installation of 6 Hammel oil burners and air chamber on oil line to reduce steam for atomization and improve combustion	340
Hose, boiler tube cleaner and Navy boiler compound	140
Use of hollow staybolt steel plugs and plastic cement to prevent entrance of cold air to furnace	50
Installation of oil meters	100
Removal of 250 ft. of dead-end steam pipes	25
Insulation of steam pipes in boiler room	150
Insulation of ends of boiler drums	150
Installation of lubricated blow-off valves to prevent leaks and reduce repairs and maintenance of previous valves	45
Connections to utilize exhaust in place of live steam to heat oil for burners	20
Installation of steam traps to prevent waste of steam	110
Installation of 400-hp. feedwater heater	1,238
Repairs to dampers to make them adjustable	25
Installation of steam soot blowers to facilitate effective removal of soot from tubes	50
	$2,683

In view of the fact that the H. & T. C. handles only passenger engines and that all demands upon the power plant vary with the engines handled, the number of engines washed each month represents the most accurate index of output of the plant. This demand upon the plant consists of steam for firing up engines, power in the machine shop, air and oil and water supply. The demand increases in winter due to the necessity for heating a few buildings and for heating oil. The following is a record of all engines which were washed or had their water changed, this being the only official and accurate record available. This work necessitates washing, filling, pumping and heating oil, pumping water and a due percentage of other mechanical operations.

Engines washed or having water changed at H. & T. C. terminal

Month	1924	1923
January	554	462
February	550	435
March	587	486
April	553	492
May	572	527
June	594	527
July	663	570
August	605	566
September	499	545
October	486	569
November	451	560
December	542	561
Totals	6,656	6,300

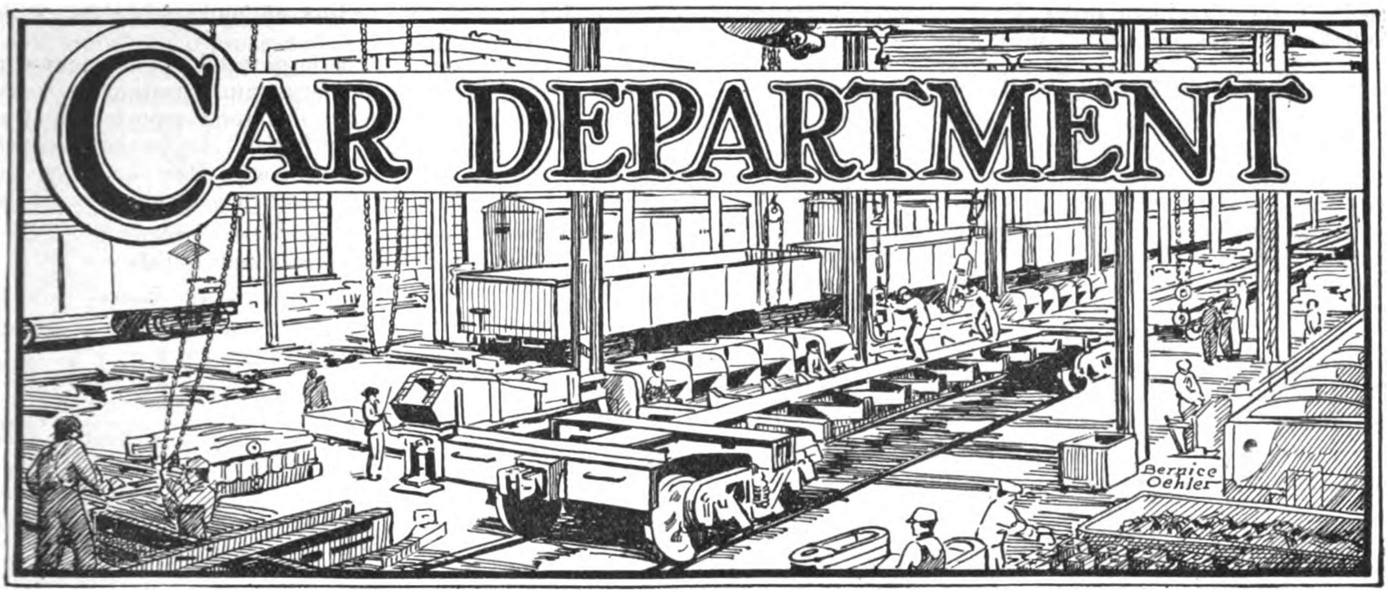
Quantity of fuel by months—1924 price per gallon

Month	Gal. of oil 1924	Gal. of oil 1923	Average price per gal. 1924
January	112,500	88,827	$0.03545
February	92,816	73,640	0.03496
March	90,903	100,948	0.03467
April	83,511	101,800	0.03451
May	78,294	93,425	0.03352
June	65,685	88,177	0.03418
July	62,698	95,391	0.03401
August	59,567	107,820	0.03439
September	59,480	97,633	0.03398
October	63,312	91,710	0.03276
November	56,367	107,610	0.03231
December	77,474	112,963	....
Totals	902,607	1,159,944	$0.37474
Average			$0.03407

In order to determine the savings made at this plant, three methods may be used. First, the difference in the total oil burned in the two years, 257,337 gal. at the average price of oil, $.034 per gal., is $8,749 a year.

A second method would be to compare the last six months of each year. This more nearly reflects the rate of savings, as most of the important improvements were completed during the first half of 1924. This difference is 613,127—378,898, or 234,229 gal., which at $0.034 a gal. equals $7,964 in the six months. This is equivalent to $1,327 a month or $15,924 a year.

A third method would be to base the savings on the fuel record for December of the two years, as in each case it was obtained from an oil meter and is accurate. December, 1924, included several unusual days of ice and sleet and might not indicate the full savings. On this basis the reduction in fuel is 35,489 gal., which at $0.034 a gal. is equal to $1,206 a month or $14,472 a year. These improvements were made under the direction of H. M. Lull, chief engineer, Southern Pacific, Texas Lines.



Car orders placed during 1924

Last year shows a marked increase in equipment orders placed by railroads in the United States

ORDERS for both freight and passenger equipment placed in 1924 by the railroads were of an exceptional volume. Freight cars ordered for service in the United States totaled 143,728. This compared with the 94,471 in 1923 and 180,154 in 1922. Except for 1922 the 1924 total was the largest for any year since 1916. Passenger cars ordered for service on the railways of the United States totaled 2,554, which compared with the orders for 2,214 cars in 1923 and 2,382 cars in 1922; it was the largest number ordered in any year since 1913.

Freight car orders

The Canadian orders for cars placed with Canadian builders totaled only 1,867, as compared with 8,685 in 1923.

The National Railways of Mexico ordered 1,740 cars from builders in the United States; other export business amounted to 2,277 cars.

Table I—Orders for freight cars since 1915

Year	Domestic	Canadian	Export	Total
1915	109,792	......	18,222	128,014
1916	170,054	......	35,314	205,368
1917	79,367	......	53,191	132,558
1918	114,113	9,657	53,547	177,317
1919	22,062	3,837	3,994	29,893
1920	84,207	12,406	9 056	105,669
1921	23,346	30	4,982	28,358
1922	180,154	746	1,072	181,972
1923	94,471	8,685	396	105,552
1924	143,728	1,867	4,017	149,612

Freight car production in 1924 totaled 113,761 cars, as compared with 175,748 cars in 1923. Up to April 30, 1924, orders had been placed for about 70,000 cars. There were, however, practically no orders placed during the following four months. Freight car purchases reported in May, June and July together totaled only 1,355 cars, and those reported in August but 4,751 cars. Improved conditions in September, and since, have changed the situation with the result that, unlike 1923, as much business was placed by the railroads for this class of equipment in the second half of the year as in the first half.

The year 1924 was characterized by some unusually large orders. The New York Central Lines purchased over 20,000 cars. The Pennsylvania purchased one lot of 12,000 in the spring, and another of 10,000 in September, all A.R.A. standard cars and totaling in value $46,500,000. The Illinois Central purchased 6,200 freight cars, and its total purchases of equipment aggregated $25,000,000. Other large purchases included the Norfolk & Western, 11,000; the Louisville & Nashville, 5,700; the Southern Railway, 8,948; the Chesapeake & Ohio, over 10,000; the Missouri Pacific, not including its subsidiary, the American Refrigerator Transit Company, over 4,000; the Reading, 4,050; the Atchison, Topeka & Santa Fe, 7,200, etc.

Table II—Freight cars built in 1924

	United States	Canada	Total
Domestic	113,761	1,721	115,482
Foreign	1,141	....	1,141
	114 902	1,721	116,623

	United States			Canadian			
	Domestic	Foreign	Total	Domestic	Foreign	Total	Grand Total
1913	176,049	9,618	185,667	22,017	......	22,017	207,684
1914	97,626	462	98,088	6,453	......	6,453	104,451
1915	58,226	11,916	70,142	1,758	2,212	3,970	74,112
1916	111,516	17,905	129,421	......	......	5,580	135,001
1917	115,705	23,938	139,643	3,658	8,100	11,758	151,401
1918	67,063	40,981	108,044	14,704	1,960	16,664	124,708
1919	94,981	61,783	156,764	6,391	30	6,421	163,185
1920	60,955	14,480	75,435	......	......	......	......
1921	40,292	6,412	46,704	8,404	745	9,149	55,853
1922	66,289	1,126	67,415	458	100	558	67,973
1923	175,748	2,418	178,166	......	......	......	......
1924	113,761	1,141	114,902	1,721	......	1,721	116,623

The types of freight cars ordered for service in the United States, Canada and Mexico are shown in Table III. None of the cars ordered were of unusual capacity,

such as the Virginian order for 1,025 gondola cars of 240,000 lb. capacity, placed in 1923.

Comments on freight car design

The question of outstanding interest in the field of freight car design is the ultimate status of the proposed A.R.A. standard designs for single and double-sheathed box cars. These designs, which are the result of the work of a committee representing more than two-thirds majority of the members of the Mechanical Division required to secure their adoption, were first presented at the 1923 meeting of the division. Since that time they have been through many vicissitudes of letter ballots, reconsiderations and slight modifications and the double-sheathed steel design is now back in the hands of the Mechanical Division for further consideration because of

Table III—Types of freight cars ordered in 1921 for use in the United States, Canada and Mexico

Type	Number	Per cent
F.—Flat and Logging	4,103	2.8
G.—Gondola	26,229	17.8
H.—Hopper	18,674	12.7
R.—Refrigerator	14,447	9.8
S.—Stock and Poultry	5,836	3.9
T.—Tank	3,439	2.3
X.—Box	54,600	37.0
Automobile	15,082	10.2
Ballast, Dump and Ore	2,726	1.8
Not classified	1,489	1.0
N.—Caboose	710	.5
	147,335	100.0

considerable objection to the inside dimensions on the part of the members of the general committee of the Mechanical Division. Until the future status of these designs is completely settled, there will probably be no marked innovations in the design of the types of equipment to which they apply and on this settlement probably depends the future activity of the Mechanical Division with respect to other types of cars.

But notwithstanding the long uncertainty as to their fate, these designs and the recently adopted standard construction details of the Mechanical Division are having a real influence on car construction. While few railroads have specified complete adherence to them, they are serving as the basis or point of departure in the design of much of the box car equipment built or building in

Table IV—Orders for passenger cars since 1916

	Domestic	Canadian	Export	Total
1916	2,302	...	109	2,411
1917	1,124	...	43	1,167
1918	9	22	26	57
1919	292	347	143	782
1920	1,781	275	38	2,094
1921	246	91	155	492
1922	2,382	87	19	2,488
1923	2,214	263	6	2,483
1924	2,554	100	25	2,679

1924. The A.R.A. standard center sill sections are gaining adherents and are being employed in new construction to a considerable extent in spite of an unfavorable price differential charged for these sections by the mills, as compared with standard structural material. This handicap, however, can hardly be considered as permanent and, as the demand increases the tonnage of these sections, they will undoubtedly be obtainable at current structural steel prices.

Passenger car orders

The production of passenger train cars for domestic service in the United States totaled 2,150, as compared with 1,507 in 1923. The 1924 production was the largest reported since 1914, in which year 3,310 cars were built. Railways in Canada placed orders for 100 passenger cars with builders in Canada, this amount comparing with 263 in 1923.

One of the reasons for the large total of passenger car purchases in 1924 was the large authorizations of cars for the Pullman Company. The total reported by the company as having been authorized to be constructed for Pullman Company service was 506, inclusive of parlor, sleeping, library and even a few dining cars. This

Table V—Passenger cars built in 1924

	United States	Canada	Total
Domestic	2,150	167	2,317
Foreign	63	...	63
	2,213	167	2,380

Comparison with Previous Years

	United States			Canadian			
Year	Domestic	Foreign	Total	Domestic	Foreign	Total	Grand Total
1913	2,559	220	2,779	517	....	517	3,296
1914	3,310	56	3,366	325	....	325	3,691
1915	1,852	14	1,866	83	....	83	1,949
1916	1,732	70	1,802	37	....	37	1,839
1917	1,924	31	1,955	45	....	45	2,000
1918	1,480	92	1,572	1	....	1	1,503
1919	306	85	391	160	....	160	551
1920	1,272	168	1,440	...	....	...	...
1921	1,275	39	1,314	361	....	361	1,675
1922	676	144	820	71	....	71	891
1923	1,507	29	1,536	...	....	...	...
1924	2,150	63	2,213	167	....	167	2,380

number was considerably above the amount ordinarily authorized by that company and presumably results from the attention that is being given to high grade passenger service throughout the country. The railroads, of course, were large buyers and several very sizable orders were reported, including notably one lot of 215 suburban cars for the Illinois Central, in addition to 66 through line cars. Another large buyer was the New York Central Lines, which together placed orders for no less than 394 cars.

During the war period and immediate post-war passenger car purchases were small. In 1918, for example, there were orders for only 9 cars; in 1919, for only 292,

Table VI—Types of passenger equipment ordered for use in the United States and Canada

Type	1922	1923	1924
Coach, combination, passenger, etc.	1,337	736	952
Sleeping, parlor, chair, etc.	248	488	543
Dining	71	76	133
Baggage, express, mail	486	415	555
Express refrigerator	270	400	410
Milk	25	323	12
Horse	19	16	34
Private, business, miscellaneous	9	15	15
	2,465	2,469	2,654

and in 1921 for but 246. For the past three years the railways have had opportunity to catch up on the deferred requirements. They have particularly made marked progress with reference to replacing wooden with steel equipment.

Information relative to the types of passenger cars ordered in 1922, 1923 and 1924 will be found in Table VI, which includes all the cars ordered for service in the United States and Canada.

Interior arrangements and finish are principal developments in passenger car design

In considering the developments of 1924, little can be said with respect to the structural design of passenger cars. The principal developments have had to do with interior arrangement and with more originality of expression in the esthetic side of interior finish.

The most pronounced innovation during the year was probably the adoption of an unsymmetrical seating arrangement in cars used for suburban service, which

provides for two persons per seat on one side of the aisle and three persons per seat on the other side of the aisle. The maximum seating capacity is thus increased by approximately one-fourth in a class of service where seating capacity is at a premium during comparatively short periods of time. This arrangement is used notably on the New York, New Haven & Hartford in the east and on the Missouri Pacific in the west.

The Pullman Company during the past year has developed a distinctive treatment of the interior decorations of its parlor cars for use on certain preferred lines which not only adds variety to the general character of interior appearance, but represents in itself a most pleasing and harmonious effect. Apparently the reaction from the elaborately carved and over-decorated type of interior finish commonly incorporated in all cars 40 years ago has run its course and the period of monotonous severity of interior treatment is ended.

To increase output of coach repairs

Use of straight line methods proposed in two alternate shop designs

By Lawrence Richardson
Whiting Corporation, Chicago

The gratifying results obtained from the application of straight line principles to freight car repair shops warrant their consideration for passenger car and locomotive shops. In one case the increase in production per man hour on freight car work was 48 per cent. To secure this increase large additional facilities would be warranted but actually the necessary changes in old shops are small and new shops can be constructed on a straight line basis at little, if any, additional cost.

Straight line passenger car repair shop layouts are shown in diagrammatic plan in Figs. 1 and 2. The main thought has been to bring out the basic principles rather than to try to show the details of an actual layout. Available property invariably sets up limitations that call for a special study of each case. This fact is recognized in the two layouts shown, one being for a long narrow area and the other for a property more nearly a square. The principles in both layouts are the same.

While a uniform run of work and production is necessary in straight line freight car shops, it is not as essential in passenger car shops. Repetition with increasing speed results in the first case while reduction in the movement of material is the basic idea in the passenger car layout. A study of the time actually spent working and that spent moving or getting material shows that these are about equal. Reduction of the percentage of unproductive time is the main idea worked out in the layouts shown. A limited specialization is also possible.

The basis of the layouts is an inbound track where the operations are performed in their usual sequence, and an outbound track where the operations are performed in the reverse sequence. The individual shops are laid out between the inbound and outbound tracks so as to permit direct straight line movement of the material from one track to the other. The distance between these tracks is made a minimum, consistent with the amount of space required for the repairs. This in turn reduces the movements to a minimum. All the worn parts start moving from the inbound track through the repair operations to the outbound track where they accumulate as repaired parts, movement being in one direction only. If any operator does not hold the required pace and keep up to the schedule, the work will pile up back of him. The effect of this is to speed him up in an effort to hold his own. Sometimes he hardly realizes that he is being forced—at other times, he is anxious to avoid the remarks of his fellow-workmen. In either case, it is not necessary for the foreman to drive the man. It thus automatically helps to eliminate the chief source of friction in a shop.

Under the old system, a pile of material did not indicate much. Under straight line production, it immediately points to delay and trouble. In this way a foreman can easily see where his attention is needed. Instead of running around a large part of the time, he can devote the bulk of his efforts to strengthening his organization and perfecting methods. In discussing straight line production with a foreman in a manufacturing car shop, he made the statement that about all he had to do was to blow the whistle every hour. If any particular stage did not shift, he could locate it at once. His main effort was bent on breaking in new men and checking the condition of tools.

The value of shop schedules seems to be an agreed fact. However, there is a tendency among men accustomed to other methods to forget them. Straight line production demands a close adherence to schedule, thus assuring the benefit to be gained from this method of operating shops.

The localization of stripping and fitting is advantageous. Since all of the stripping is done at one point, the bulk of the dirt is kept from the shop proper. This makes it much easier to keep the premises clean. Inspection is also centralized. In doing the bulk of the fitting on the outbound track, it is possible to have specialized gangs do this work. An increase in production of 50 per cent in such cases is not unusual. Benches and special machines can be located adjacent to such points, so that the men can get the full benefit of them. It is a case of less walking and more working. This point can be better appreciated by considering a shop 700 ft. long. A walk to one end and back means one-quarter of a mile. This is not unusual. Pedometer tests on workmen have shown surprising distances covered in the course of a day's work.

Inasmuch as the finishing work is done on one outbound track, it is possible to make all the necessary final inspections without traveling through the shop. This results in better and more efficient supervision. As the inspectors have a permanent location, it is possible for them also to assume supervisory duties, thereby reducing the overhead charges. Some roads prefer to have the re-trucking and final inspection made outside in order to get the benefit of full daylight. In this case, the outbound track would be just outside the shop instead of just inside as shown.

The individual shops are arranged in the sequence in which the work is to be done, the first operation being the

removal of batteries. Therefore, the battery shop is the first shop on the inbound track. In view of the tendency to separate the battery shop from the rest of the repair shops, on account of the fumes and other features, it has been shown in a separate building. The worn batteries are received at one end of the shop, moved through the shop as they are repaired and dispatched through the opposite end in good condition. At this point they meet the outbound car in its last position where they are replaced just before the car is turned out for service. In many cases, the battery shop also takes care of batteries shipped in from road points. Such shipments can be readily handled in the layout shown without interference with the current repair work.

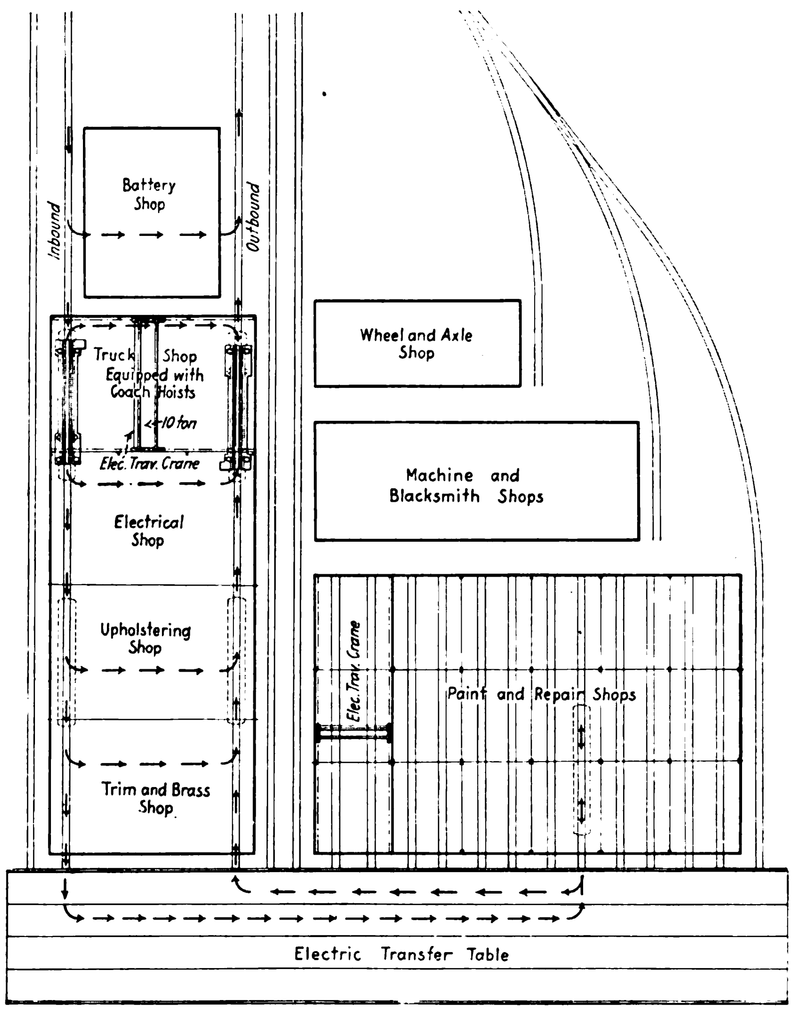


Fig. 1—Straight line passenger car shop layout for an approximately square area

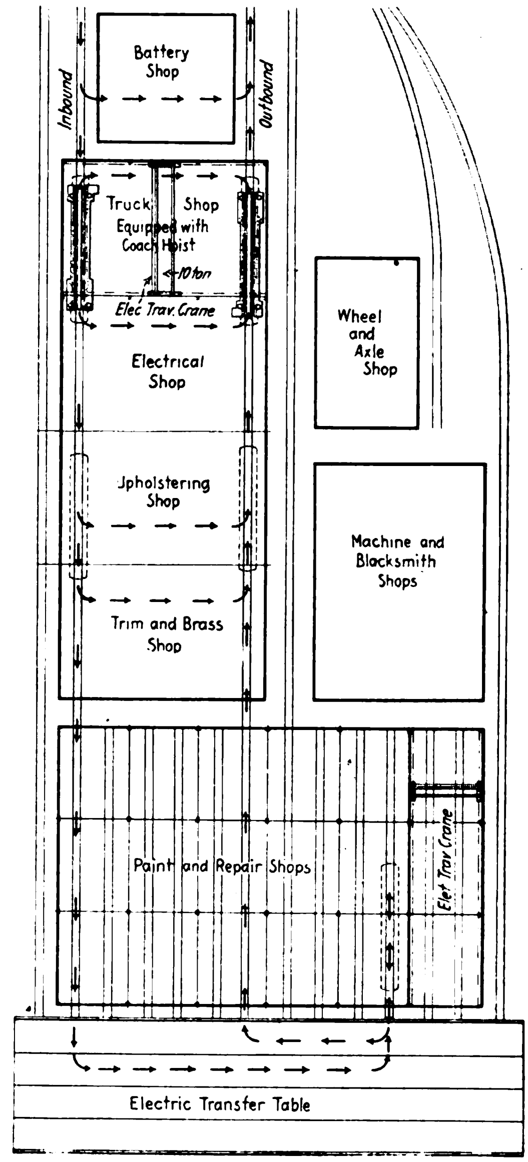


Fig. 2—Straight line passenger car shop layout for a long, narrow area

Design and location of truck and wheel shops

While the location of the truck shop is more or less optional, it has been shown in this location in order to make it adjacent to the wheel shop. In view of the fact that the wheel shop does as much work for outside points as it does for the repair shop, it has been located so that carloads of wheels received from outlying points may be moved in or out without interfering with the general shop operations. To handle the truck work properly, this shop should be provided with crane service. It is possible to give this crane enough capacity to untruck the cars although the more economical way would be to provide a lower capacity crane capable of handling a truck. The cars could then be untrucked by the use of portable coach hoists, or jacks, the crane being used for removing the trucks and handling them through the truck shop. Shop trucks are used for the movement of the car body to and from the main shop. The shop trucks released from the outbound cars are moved across the truck shop and placed under the inbound cars. When the shop is running full capacity, as soon as one car is finished, another one to be repaired takes its place. The one turned out releases a track—and a pair of trucks—to the inbound car. This means that no storage of shop trucks is required. Only when a truck is left unoccupied is it necessary to store shop trucks.

The electrical shop is located next, in order to handle the electrical generators from the trucks as well as electrical apparatus from the cars. The movement through the electrical shop conforms to the general principles mentioned in connection with the truck and battery shops.

The upholstering shop is next. The space for this shop may be a second floor above one of the other shops as only light machinery is required and the cushions and chairs are easily handled. If necessary, storage may be provided in mezzanine galleries. The trimmings and brass work are removed at the last position and moved through the trimming and brass shop in accordance with the principles mentioned.

If desired, this last space may be separated from the shop proper and used as a scrubbing room. In this way, an extra move can be saved before placing the car bodies in the general repair shops.

The number of stops on the inbound and outbound tracks may be regulated to suit the production required. If the output is limited, two stops will be found sufficient as indicated by the dotted lines. If the output is increased, it can be taken care of by increasing the

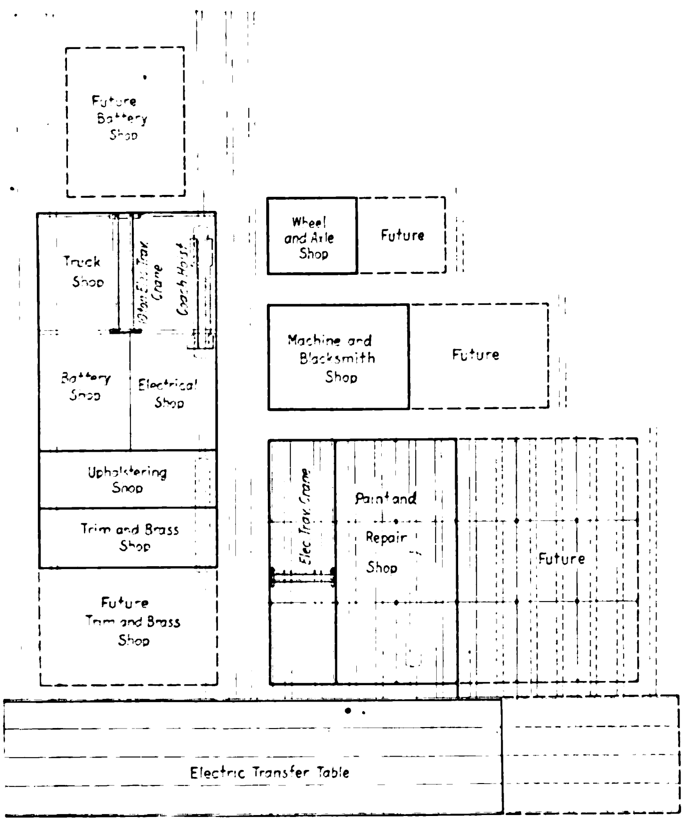


Fig. 3—A small shop layout on the straight line principle with provision for expansion

stops, space having been provided so as to make this number as high as five.

Movement of cars

The movement of the cars from stage to stage may be accomplished in several ways. No one way is best in all cases as conditions vary widely. The weight of the cars has an important bearing. The four methods usually employed are: (1) By a shifter or tractor, (2) by a winch, (3) by hand movers, or (4) by gravity. The last method is to be preferred, when possible to use it, on account of the minimum effort and time required. If the track is given 5 in. drop per hundred feet, the car can be moved readily. With this fall, the car will not start itself. On the other hand, in summer weather, when started, it can be kept moving easily. Sometimes it only requires pushing by hand. Hand car movers are used to give it a start.

After the car is stripped and scrubbed it is removed to the general repair shop by means of a conventional type of **transfer table.** Here it is painted and given repairs in accordance with usual practice. Both operations may be done in one shop or there may be separate repair and paint shops. The largest owners of special and passenger cars have found it satisfactory to do both operations in one shop. This saves several moves. The use of ovens for baking or drying calls for additional moves.

Cars, including wrecks, which need extra heavy repairs, require a considerable amount of heavy lifting. This can best be accomplished by the use of cranes. As the number is usually small, only two tracks have been set apart for this purpose.

The short span gives a low cost crane. This heavy repair shop should be walled off from the other tracks on account of the dust raised as well as the noise.

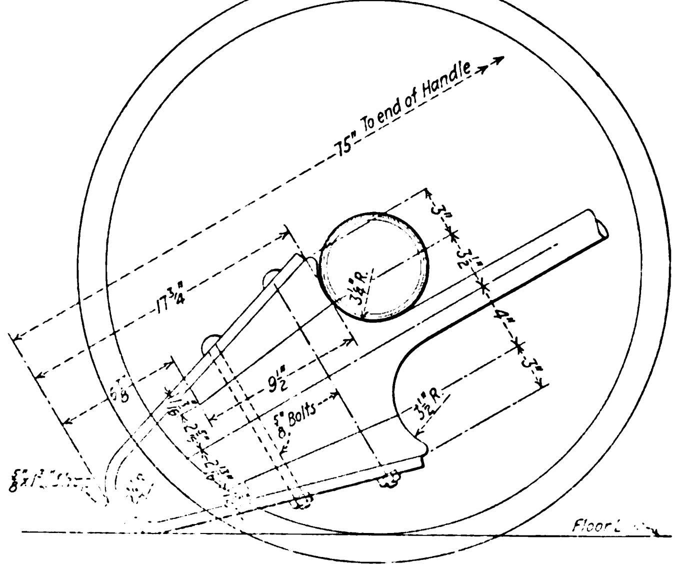
Small shop layout

In cases of roads not having enough equipment to warrant separate inbound and outbound layouts, it is possible to use one track for the purpose at first. Expansion can then be effected by transferring one of the operations to a far track. The development is shown in Fig. 3.

It will be noted that the first cost of the layouts shown is approximately the same as for standard shops. If anything, the first cost should be less as the faster movement requires less space. This makes the economy effected by the increased man-hour productions a net gain.

Wheel stick with renewable blocks

THE simple wheel stick has long served a useful part in practically every car repair yard and shop. In the accompanying drawing is shown one that is in use at the North Billerica Shops of the Boston & Maine, which appears to be a real improvement over the usual type in that the ease of renewal of worn parts has been taken into consideration. Except for the 5/8-in. by 1 3/4-in. strap iron



Method of using wheel stick

around the outside of the head, the whole device is constructed of straight grained hardwood. The strap iron protects against wear where contact is made with the floor or ground and, at the point where the axle rests on the wood, it will be noticed that renewable blocks are provided. Round head bolts hold the parts of the head in place and renewal of parts can be rapidly accomplished.

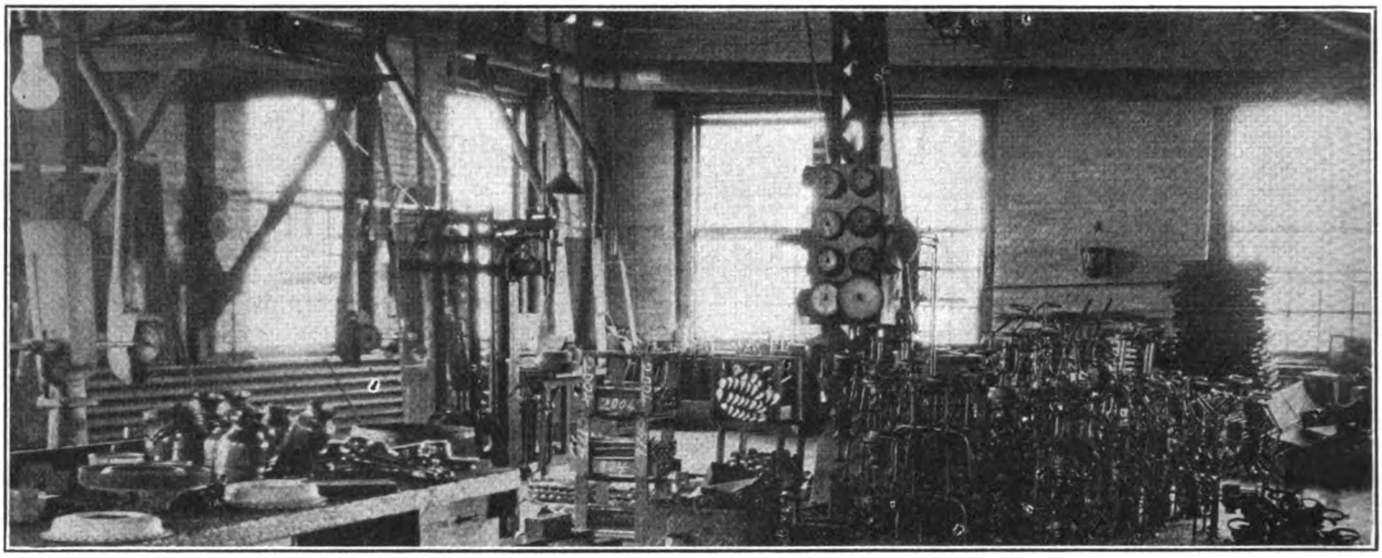
Renovating interior trimmings of passenger cars

A discussion of copper, nickel and silver plating processes used at the Billerica shops of the Boston & Maine

Part II

THERE appeared in the January issue of the *Railway Mechanical Engineer* a complete description of the methods used, at the Billerica shops of the Boston & Maine, of renovating passenger car seats in the upholstering department. On the same floor and connected to this department is the lacquer room in which modern methods are employed in copper, nickel and silver plating.

The brass trimmings of passenger cars, such as baskets, oil and gas lamps, seat arm caps, window fixtures, etc., are removed from the cars by the outside stripping gang. They are brought to the lacquer room where they are taken apart preparatory to cleaning and hung on brass wires ready for renovation.



General view of the lacquer room, showing buffing machines and repair benches

Oxidized or gunmetal finish

The most important factor in any plating process is to have the parts to be plated, thoroughly cleaned. This is generally accomplished in a caustic soda solution bath made up on the basis of 6 oz. of caustic soda (the chemical name is sodium hydroxide) to one gallon of boiling water. The parts to be cleaned are left in this bath from two to three hours, after which they are rinsed in clean hot water.

The parts are now black with a coating of dirt and lacquer which cannot be removed by caustic soda. This black coating is removed by dipping the work in a sulphuric acid bath, which consists of 60 per cent oil of vitriol and 40 per cent nitric acid. It is contained in an earthenware tank surrounded by cold water. The tank is kept filled by adding more acid to it each day until waste matter collects on the side of the tank. This indicates that the mixture is saturated with dirt and should be renewed. Every precaution should be taken to protect the workmen from the poisonous fumes which come from the acid. The parts are dipped in the acid twice and rinsed off in clean hot water. The brass parts now have their original bright appearance.

Method of copper plating

The plating is done in tanks containing 500 gallons of a solution made up according to the still solution formula. The acid or alkaline copper solution may be used. The acid solution is used at this shop. This is made up of the following ingredients:

Water	1	gal.
Copper sulphate	1¾	lb.
Sulphuric acid, 66 per cent	4	oz.
Powdered alum	1	oz.

The alkaline solution is made up from the following formula:

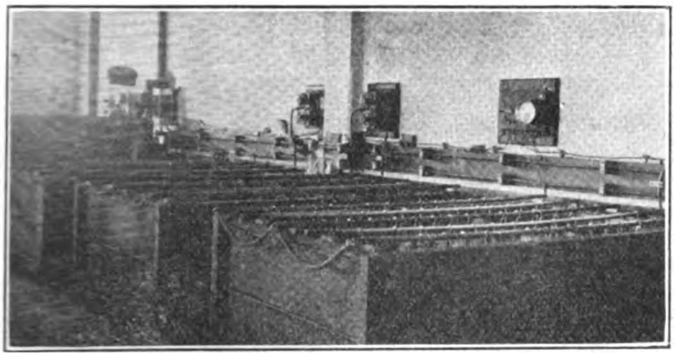
Water	1	gal.
Sodium cyanide	4⅓	oz.
Copper cyanide	4	oz.
Bicarbonate of soda	¼	oz.
Bisulphite of soda	½	oz.

The barrel or mechanical methods of plating are sometimes used. These necessitate increasing the proportions given above to twice the amount. As a rule, for mechanical solutions, the sodium cyanide and conducting salts will have to be increased 25 per cent above the amounts given for the still solutions; even though the proportions of the basic formula have been doubled.

Each tank has 18 copper anode plates which are 99 per cent copper and one per cent zinc and weigh from 12 to 14 lb. apiece. The parts to be plated are hung on the

cathode rod and remain in the tank 30 min., after which they are removed and rinsed in clean water. The electric current used in the plating process is eight volts and from 160 to 200 amperes controlled by suitable meters.

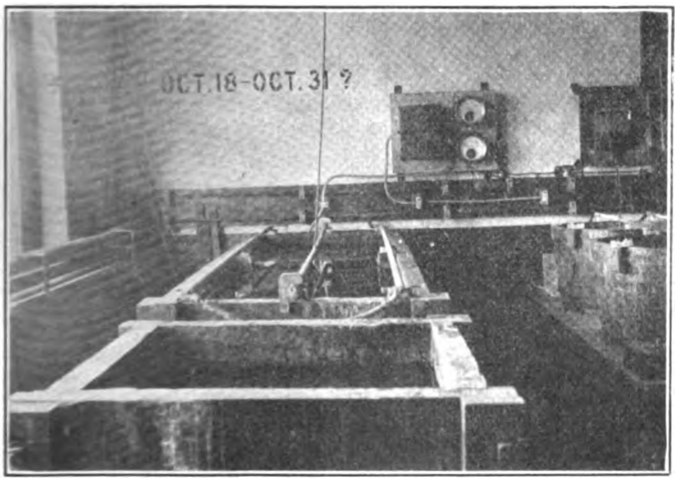
The work is now ready for the liver of sulphur bath. The chemical name for this bath is potassia of sulphurated merck. It is made up in a 150-gal. tub three times a week by mixing 5 lb. of liver of sulphur and a quart of ammonia to the tub. The parts are dipped in and out of this bath to give them the gunmetal finish. They are then rinsed in clean water and dried by compressed air, after



Copper and nickel plating vats

which they are given a scratch brush finish. The finishing process is to dip the parts in the lacquer vat, permit them to drip off and then place them in the drying room, which has a temperature of 180 deg. F., where they remain from 2½ hr. to 3 hr. They are now ready to be assembled and replaced in the cars.

If the natural brass finish is desired, they are taken directly from the sulphuric acid bath and instead of pass-



Silver plating room showing vats and electrical control board

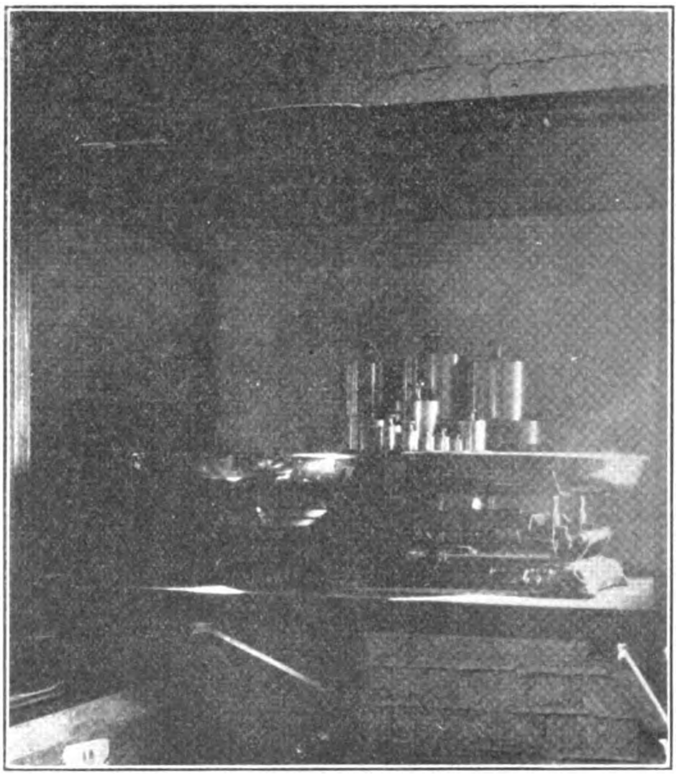
ing through the copper plating tanks, are lacquered and dried.

The requirements of copper plating

When working with solutions which are readily subjected to chemical reactions, the workman in charge must know his work and be constantly on the alert or otherwise he is liable to be responsible for expensive mistakes. It is not uncommon for the solutions to become sluggish so that they will not give uniform results even when several agents are added to increase their activity. This trouble can best be remedied by reducing the solution at least one-third with water and then adding small quantities of sodium cyanide, which will generally bring the solution back to normal again. The solution which has been removed may be heated to 180 or 200 deg. F., and metal cyanide added to increase the metal content. This may then be used as a stock solution for replenishing.

At irregular intervals the copper baths begin to give trouble. The first measure in trying to overcome this is to add common alum in the proportion of one or two ounces to the gallon. If this does not overcome the trouble, the bath needs more metal. Reduce the bath somewhat with water and then add as much sulphate of copper as the bath will absorb over night. This can readily be accomplished by suspending the copper salt in the usual acid dipping baskets made from earthenware or aluminum, upon the negative or work poles.

It is often found that when plating cast iron that the copper deposit peels or is not clear. One or two ounces of bicarbonate of soda or one or two ounces of bisulphite of soda should be added to each gallon of solution. This



Assay scales used to weigh silver bars and parts to be silver-plated

acts as a conducting salt and forms a sulphite in the solution, which is readily soluble in the cyanide. It produces a softer deposit and cleaner anodes.

The electric current must be carefully watched during the plating process. Too much current will blacken the work and not enough will give it a muddy appearance. If the process is pushed, the result will be a batch of spoiled work. On the other hand, if the parts are left in the bath too long, they will blister and peel. In this connection, it is essential that the hydrometer reading of the copper bath be maintained at 18½. When below this figure, 2 oz. of copper carbonate and 12 oz. of potassium cyanide should be added to every gallon of bath solution. If the hydrometer reads too high, reduce the solution by adding water.

Nickel plating cast iron parts

The most essential point when nickel plating cast iron is to have the parts thoroughly cleaned. The object of this

is to prevent blistering and peeling. The work is first polished with fine emery on a felt wheel, which removes all dirt, grease and old nickel. After this, the work is brushed off by a rapidly revolving wire brush. It is then washed off in caustic soda and rinsed in clean water and then scoured by hand with pumice stone and again thoroughly rinsed. The cast iron parts are now ready for copper plating. They are allowed to remain in the copper bath previously described for 40 min. When taken from this bath they are polished on a cotton buffing wheel and again run through the same cleaning process as described above. They are now ready for the nickel bath.

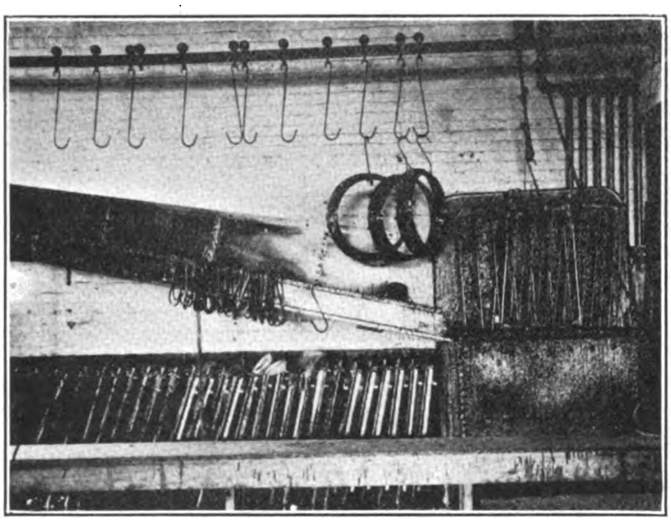
The nickel bath most commonly used for plating cast iron or steel is made up of the following ingredients:

Water	1 gal.
Single nickel salts	10 oz.
Nickel chloride	2 oz.
Boracic acid	2 oz.
Sal ammoniac	1 oz.
Epsom salts	1 oz.

This solution should give a hydrometer test of from 5½ to 7. If it is weak, it should be rebuilt with double nickel salts and water, and if strong, reduced with water. The work is allowed to remain in this bath for three hours after which it is rinsed in clean water and polished on a cotton buffing wheel.

Suggestions for nickel plating

Sometimes a nickel deposit will stain very readily. This denotes that the solution is radically alkaline. Boracic acid is commonly used for acidulating nickel baths, but for many baths, chemically pure sulphuric acid serves the same purpose at a very much cheaper cost. At the end of the day's work, to every hundred gallons of bath add 10 oz. of the acid dissolved in water and stir thoroughly. Hydrofluoric or hydrochloric acid may also be added upon the same ratio with excellent results. In the morning it will

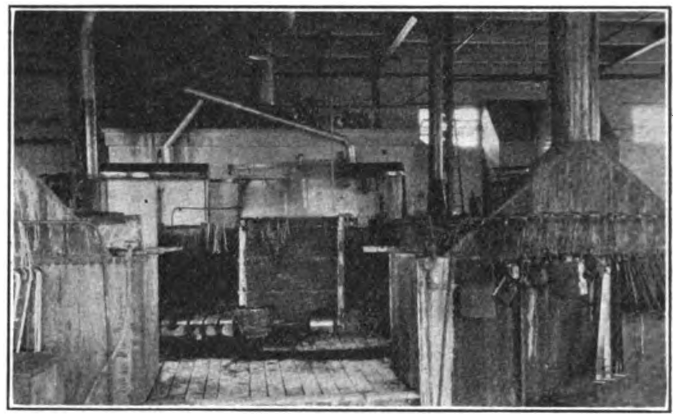


Paint vat in lacquer room, used for painting headlight casings, car gates, etc.

be found that the solution will have cleared and the staining will be overcome.

Stains are sometimes produced on nickel deposits by contaminated rinsing waters, or by drying out in sawdust that has become sour. One of the best aids to drying out nickel or any other deposit and to prevent stains is the old-fashioned plater's compound, called whale oil soap. Two ounces of this material dissolved in each gallon of boiling water will act as a dryer. The water will completely run away from the surface of the articles, thus saving labor and much sawdust.

The pitting of nickel deposits is usually caused by a deficiency of metal in the solution, or too much free acid; either case produces an excess of hydrogen gas upon the articles which appears to burn into the surface of the deposited nickel, producing pitting. The remedy is to add 2 or 3 oz. of nickel sulphate to the gallon if caused by a deficiency of metal. If caused by too much free acid, add carbonate of nickel; this is best added in the plastic form. Plastic carbonate of nickel is produced in the same manner as plastic carbonate of copper from copper sulphate, by adding two pounds of carbonate of soda to each pound of sulphate of nickel dissolved in boiling water. After precipitation, filter carefully and rewash several times with hot water. One-half to one ounce of plastic nickel car-



View showing acid vats and drying room in the rear

bonate per gallon of solution will usually overcome the free acid in a nickel bath. Nickel chloride and also nickel fluoride have been found to be excellent factors in reducing pitting. The chlorine, liberated combines with the hydrogen and is reduced to acid. A half ounce or more should be added per gallon of solution.

The peeling of nickel deposits is not always due to imperfect cleaning, imperfect removal of oxides, free acid, or free alkali in solution, but to a lack of a conducting salt. This can be remedied by the addition of common salt, sal-ammoniac, sulphate of ammonia, epson salts or nickel chloride. When the conductivity of a nickel solution is poor, dark lines will be found covered by the supporting wires or frame. A stronger current applied will not make matters any better. A conducting salt is needed, one or two ounces of which, added to each gallon of solution, will overcome this difficulty. Nickel solutions very seldom need a conducting salt; when once prepared, they do not decompose very readily, remaining quite constant. Some anodes are very hard, especially those cast in chilled moulds, and they do not reduce readily; any disturbance then noted would be due to a lack of metal in the solution, unless the bath had become contaminated with some foreign substance.

When nickel solutions are in a good working condition it is easy to maintain them even when worked constantly during the day. The amount of nickel deposited is not entirely replaced by the anodes even when as much anode surface is exposed to the action of the bath as can be conveniently placed upon the supporting rods.

Equipment for silver plating

Locomotive headlight reflectors are the important items which are silver plated at this shop. Those needing refinishing are collected until a batch of 40 or 50 are ready for renovation. This is done because it is not economical to silver plate a few items at a time. The silver plating is done by the foreman in charge of the department, who is

held responsible for each ounce of silver in his possession, and therefore, keeps a close check on the consumption of the silver and the cost of plating.

The silver plating tubs, scales for weighing the silver anodes, distilling equipment which furnishes distilled water for the Boston & Maine System, and the safe, in which the silver bars are kept are enclosed in a heavy steel wire cage which is always kept locked when not in use. The wooden tub for silver plating will hold 180 gal. of bath and, when not in use, is covered over with a canvas hood to keep out foreign matter. The bath and parts being plated are agitated by means of a rod which is attached to the cathode or rod on which the work is suspended. This rod is rocked back and forth by means of a ¼-hp. motor. The object of this idea is to keep in constant contact with the work, a part of the solution that is saturated with silver deposits so as to obtain a uniform coating of silver on the reflectors.

The following is the formula used when preparing a bath for silver plating:

Water	1 gal.
Sodium cyanide	7 oz.
Silver chloride	4 oz.
Ammonium chloride	½ oz.

This bath is maintained to give a hydrometer reading of 18½. If it becomes weak it is built up by adding sodium cyanide and silver chloride and if too strong is diluted with distilled water. The silver bars which serve as the anodes are carefully weighed before and after using. This determines the amount of silver used. The current used is 160 amp. and from 6 to 8 volts. The general idea of the arrangement of the silver plating room can be obtained from the illustrations accompanying this article.

Silver plating headlight reflectors

Parts to be silver plated are cleaned with greater care than in the processes already described. This is essential, when silver plating, in order to prevent blistering or peeling. The parts are first cleaned in hot caustic soda which removes loose dirt and grease. They are then dried and buffed on a cotton wheel, after which they are stenciled serially on the inside from one up. This is done for weighing purposes in order to determine the amount of silver deposited on each reflector. To prevent the backs of the reflectors from being plated, they are lacquered. They are next given a bright copper finish by polishing on a cotton buffing wheel using Acme white finishing compound. They are again washed off with hot caustic soda, rinsed with hot water, and then cleaned by hand with pumice stone. They are next immersed for five minutes in a mercury bath which provides a base for the silver to adhere to. This bath is made up of cyanide of potassium, a mercury and distilled water. The reflectors are again cleaned with pumice stone and a hand brush and rinsed off in hot water. Each reflector is now carefully weighed and placed on the cathode rod of the silver bath. It remains here about 25 min. during which time approximately .75 ounces of silver is deposited on each reflector. When the plating process is finished the reflectors are allowed to drain off. They are then rinsed in distilled water and dried with compressed air. They are again weighed and then given the final finish by polishing with rouge.

The table shows the cost of silver plating 44 reflectors. Labor and material required for 44 reflectors:

Labor charges

Buffing.—	18 hr. 48 min., @ 66c an hour	$12.41
Plating.—	20 hr. 24 min., @ 73c an hour	14.89
Total	**39 hr. 12 min.**	$27.30

Material charges

Tripoli, 4 lb., @ 12½c a lb	$0.50
Lacquer, 1 qt., @ $1.00 a qt	1.00
Acme white, 3 lb., @ 23c a lb	.69
Rouge, 1 lb., @ 43c a lb	.43
Buffing wheel, 5 sections @ 45c a sec	2.25
Silver, 30.17 oz., @85c an oz	25.64*
Total Material	$30.51
Total Labor	27.30
Total cost of plating 44 reflectors	$57.81
Cost of each reflector	1.31

*Weight of anodes before plating	355.94 oz.
Weight of anodes after plating	325.77 oz.
Amount of silver used	30.17 oz.

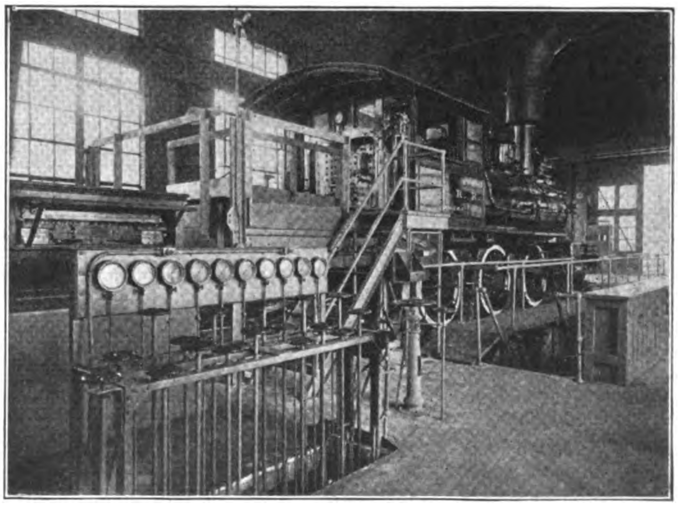
Suggestions for silver plating

Care must be taken when preparing a new silver bath not to add too much free cyanide to it as it is much better to have an excess of undissolved silver salts in the bottom of the tank than an excess of cyanide. A new bath is sometimes very erratic. A little water of ammonia added to a new bath helps to age it, and a little ammonia added when the anodes have a tendency to turn dark or black will be found of value. If too much cyanide has been added to the bath at any time, add a little nitrate of silver, one-quarter ounce to a gallon. This will be found better practice than trying to take up the free cyanide with chloride or cyanide of silver.

In freshly prepared silver baths the silver deposit is sometimes dark and granular, and because of the low voltage the anodes do not readily yield up their metal. If small amounts of ammonium chloride or potassium carbonate do not correct the trouble then it is advisable to increase the internal resistance by adding very small portions of a brightening colloid.

Other parts renovated

Various other miscellaneous parts are repaired in this department. Car locks and lamps are repaired and refinished. Headlight casings, car gates and brake levers are painted by the dipping process. These parts are brought to the shop repaired. They are then cleaned in caustic soda thoroughly dried after which they are then dipped in the paint vats, allowed to drip and then placed in the drying room for four hours. One of the illustrations shows the paint vats with headlight casings hanging on hooks suspended from the monorail. This shop can completely renovate the trimmings of four cars each day.



Interior view of the locomotive testing laboratory at the University of Illinois

Improving car department service*

Methods used by the "Milwaukee" for reporting bad order cars and repairs—Problems of personnel

By L. K. Sillcox

General superintendent of motive power, Chicago, Milwaukee & St. Paul, Chicago.

Part II

WORK coming under A. R. A. rules is of such large proportions that the importance of systematizing and organizing the work is very apparent to all concerned. In the past, much of the billing work consisting of transcribing records of various kinds on to the A. R. A. billing card, resulted in mistakes and misinterpretations because the transcribing was usually done by clerks who did not understand the work. At the larger points where many men are engaged and much foreign line work is done, it is possible to reduce the transcribing very materially by using the A. R. A. billing repair card as the original record, having it filled in by the car man or checked at the work and forwarding it to the central billing office for the usual collection. It is necessary to have what is termed the original record, which is to be filed at the point where the work was done and it is considered that this requirement is met by keeping a carbon copy of the A. R. A. billing card at the local points for this purpose.

The method of recording material applied to freight cars differs greatly on the various railroads. Some charge material used from the slips made for drawing material, whereas others charge out the material from records of work done on the car. In the case of foreign car repairs it is possible to use the billing repair card when material is charged out as applied instead of as drawn in case the latter method is used.

The education of inspectors, checkers, repair men, etc., employed in handling foreign line repairs, should be followed closely and traveling inspectors are found to be of very great importance in the proper handling of this work. Periodical bulletins should be issued from time to time showing recent interpretations of rules and also giving answers to all questions submitted to a central office by inspectors.

The practice of following up the bad order car situation is now practically the same throughout the country, the

F 9 24 20 M

Form 85

CHICAGO, MILWAUKEE & ST. PAUL RAILWAY COMPANY

TO PUGET SOUND-ELECTRIFIED

CAR DEPARTMENT

DAILY TELEGRAPHIC REPORT OF BAD ORDER CARS ON HAND AND REPAIRED AT 6:00 P. M.

FILED 1:49 A. M. LOCATION General Shops November 22nd 1924

NO. OF SYSTEM CARS LOADED AND EMPTY

LOCATION	Box On Hand A	Box Repaired Since Last Report B	Furniture and Carriage On Hand C	Furniture and Carriage Repaired Since Last Report D	Automobile On Hand F	Automobile Repaired Since Last Report G	Refrigerator On Hand J	Refrigerator Repaired Since Last Report K	Vegetable and Beer On Hand M	Vegetable and Beer Repaired Since Last Report N	Stock Single Deck On Hand Q	Stock Single Deck Repaired Since Last Report R	Stock Double Deck On Hand U	Stock Double Deck Repaired Since Last Report W	Flat On Hand X	Flat Repaired Since Last Report AB	Coal On Hand AC	Coal Repaired Since Last Report AD	Ore On Hand AF	Ore Repaired Since Last Report AG	Caboose On Hand AJ	Caboose Repaired Since Last Report AK	Work and Miscellaneous On Hand AM	Work and Miscellaneous Repaired Since Last Report AN	Special Equipment On Hand AQ	Special Equipment Repaired Since Last Report AR	Foreign Tank Cars On Hand AS	Foreign Tank Cars Repaired Since Last Report AU	Foreign Other Than Tank and Special Equipment On Hand AY	Foreign Other Than Tank and Special Equipment Repaired Since Last Report AX	Totals Loaded On Hand BA	Totals Empty On Hand BC	Totals Loaded Repaired Since Last Report BD	Totals Empty Repaired Since Last Report BF
Repair Track	75	20			14	4	1				17	1			32		19	2	7		11		2		1		1	1	11			191	2	26
Belt	39				1										5		74															119		
WIRE THIS PORTION																																		
TOTAL	114	20			15	4	1				17	1			37		93	2	7		11		2		1		1	1	11			310	2	26

CLASS OF REPAIRS REQUIRED CARS ON HAND; CLASS OF REPAIRS MADE SINCE LAST REPORT; THIS INFORMATION WILL BE SHOWN ON SATURDAY'S REPORT CLASS OF REPAIRS REQUIRED AND NO. OF DAYS ON HAND; SAFETY APPLIANCES SYSTEM CARS

LOCATION	Required Running On Hand CA	Required Light On Hand CB	Required Medium On Hand CD	Required Heavy On Hand CF	Required Rebuilt On Hand CG	Required Total On Hand CH	Made Running Repaired Since Last Report DA	Made Light Repaired Since Last Report DB	Made Medium Repaired Since Last Report DC	Made Heavy Repaired Since Last Report DF	Made Rebuilt Repaired Since Last Report DG	Made Total Repaired Since Last Report DH	Number of Men Working MN	Number of Men Absent MO	Weather Conditions MR	Running 2 Days or Less FA	Running 3 to 5 Days FB	Running 6 Days and Over FC	Light 2 Days or Less FD	Light 3 to 6 Days FG	Light 6 Days and Over FJ	Medium 5 Days or Less FK	Medium 6 to 15 Days FM	Medium 16 Days and Over FN	Heavy 5 Days or Less FO	Heavy 6 to 15 Days FQ	Heavy 16 Days and Over FR	Rebuilt 10 Days or Less FS	Rebuilt 11 to 30 Days FW	Rebuilt 30 Days and Over FY	Total On Hand FX	Safety Appliances On Hand to be Equipped SA	Safety Appliances Equipped Last Week SB
Repair Track				3	188	191	3	1			24	28	300	25	Cloudy										1		2	105	59	24	191		
Belt				21	98	119									Cloudy												21	6	70	22	119		
WIRE THIS PORTION																																	
TOTAL				24	286	310	3	1			24	28	300	25											1		23	111	129	46	310		

INDIVIDUAL CAR NUMBER (SYSTEM ONLY) GIVEN. REBUILT HEAVY AND MEDIUM REPAIRS

REBUILT—CLASS A			HEAVY—CLASS B				MEDIUM—CLASS C			
82740	504809	502553								
89526	500299	502896								
82264	500616	502351								
204876	502671	502565								
500744	501059	590131								
203182	591262	91352								
90638	709244	500726								
92126	590151									

DO NOT WIRE THIS PORTION

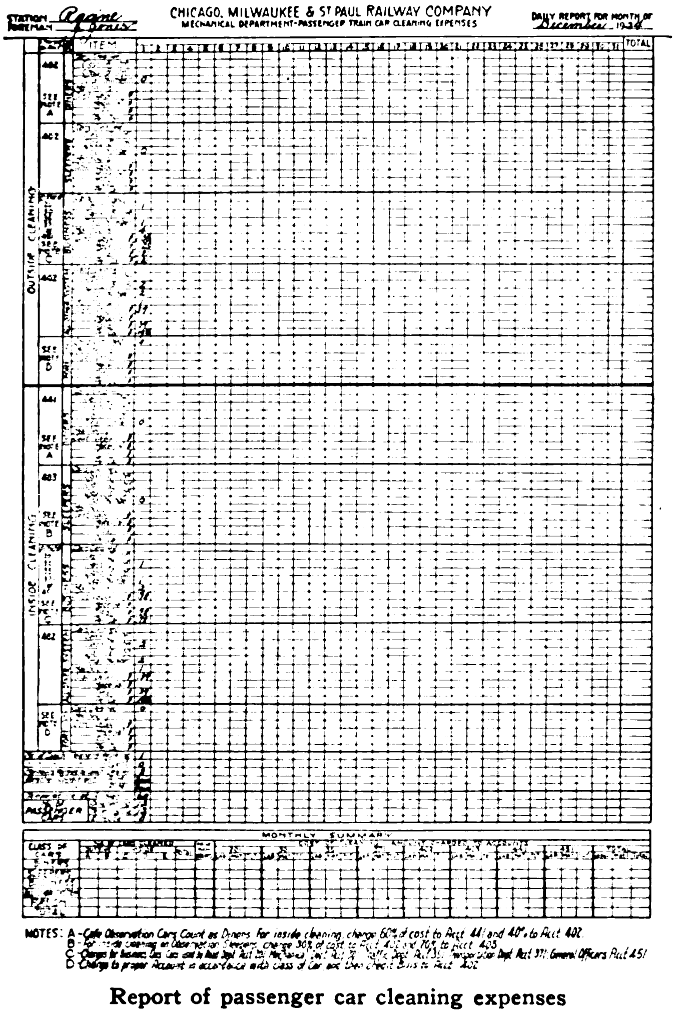
NOTE:—This report should be made out daily, except Sundays and holidays as hereinafter provided for, by foreman of each car repair station and given to Agent who will telegraph all except lower portion to C. G. JUNEAU Master Car Builder, Milwaukee Shops, each evening, and then forward the report by mail, enclosing same in envelope. Form 1518 Cars repaired and number of men working on Sundays and following holidays, New Years, Washington's Birthday, Memorial Day, July 4th, Labor Day, Thanksgiving Day and Christmas, are to be included in the report for the following day.

Signed J. Smith Foreman in Charge

Daily telegraphic report of bad order cars on hand and repaired at 6 P. M.

* The conclusion of an abstract of a paper read at the regular monthly meeting of the Car Foremen's Association of Chicago, held December 8, at the Great Northern Hotel, Chicago. The first part of this paper appeared in the January *Railway Mechanical Engineer*.

difference being only as to the matter of form and application of the data. This involves the question of classification and organization to handle the work and control the bad order situation. For the purpose of simplifying the matter, repair points can be classified, each having a stated output requirement based on the classes of heavy and light repair work handled. On the Chicago, Milwaukee & St. Paul, Class one repair points are those having 100 men or more with facilities to handle heavy and schedule work at a specified maximum output; Class two repair points are those with facilities for doing some heavy work, having no less than 15 repair men engaged in this work; Class three repair points are those having some facilities



Report of passenger car cleaning expenses

and less than 15 men engaged in repair work; Class four repair points are those stations of a lighter nature not included in the above.

Bad order car report

A sample of the daily bad order freight car repair report is illustrated which shows by kinds of cars the repairs made each day and the bad order cars left on hand together with the number of men engaged on car repair work, etc. This is a daily report which is sent to the central office for consolidation. In addition to the daily report a special statement is made once each month showing all bad order cars on hand at the end of the month by individual car numbers, initials, date bad ordered, principal defects and date expected out. The purpose of this form is to determine unnecessary or unusual delays to individual cars and to select those which have been held 30 days or more to see what can be done to overcome such delays. This report is of great value in following up per diem losses and the releasing of cars in time of shortage.

We use the blank back of the daily bad order report for special information and one of the features is a report of personal injuries occurring each day. Personal injuries are followed up closely and recorded in relation to the turnover of labor to see whether it is due to new employees or lack of safety measures, methods of handling work, etc. It is felt that in following up such matters the local foremen are placed in a position where they must naturally assume more responsibility along this line and keep injuries down to a minimum.

We also have shown on the back of this report a statement of material shortage confined to that which is handicapping the work. This shows the requisition number, the date ordered, the follow ups, etc., with a view to assisting the general officers in overcoming the situation.

A car department hand book is issued from time to time designed to embrace practically all of the activities in the handling of car work which come up from day to day and which are more or less standard.

Passenger car cleaning

In the matter of cleaning passenger cars, it is natural to suppose that this is a subject of a minor nature requiring no special records or supervision, but owing to the fact that the Chicago, Milwaukee & St. Paul owns and operates sleeping cars this requires a definite division of the cost as between departments and we have felt it necessary to go into this feature rather closely. The cost of cleaning passenger cars is charged to three different accounts, except business cars, which may go to many different accounts. The outside cleaning of all cars (except business cars) and the inside cleaning of all but sleepers, diners and business cars, is chargeable to account 402. The inside cleaning of sleepers is chargeable to account 403 and the inside cleaning of diners is chargeable to account 441. The cost of cleaning special or officers' cars should be lodged against the superintendence account according to use. This is a rather complicated procedure and as the direct cost of this work is combined with a multitude of other kinds of charges it is not possible to control the expense without dividing these accounts and determining the direct labor and material charges and the amounts allocated in spreading the overhead charges. It is possible to analyze actual individual train operation to control this expense by means of direct labor cost, but this is not always available as the information is based on a variety of data, which is not the same at all times and a mere control of the direct labor feature does not give any idea of the correctness of other allocated charges.

In order to follow up the cleaning cost properly it is necessary to have organization and classification. We are handling it as outlined on the report form illustrated, which is based on inside and outside cleaning and classification of equipment according to the division in the accounts. We have divided the classes of cleaning into the following:

(A) Outside cleaning when car is scrubbed with water and acid and trucks sprayed with distillate oil.
(B) Outside cleaning when car is scrubbed with water only and trucks cleaned with or without oil spray.
(C) Inside cleaning when car is sponged with soap and water and otherwise renovated.
(D) Inside cleaning when car is blown out, swept, dusted and mopped.
(E) Light cleaning of inside en route at intermediate stations.

The classification of cars for making the proper division of the cleaning cost to the appropriate accounts is as follows:

(1) Diners and cafe-observation cars.
(2) Sleeping, tourist, compartment sleepers and observation sleepers.
(3) Business cars.
(4) All other passenger train cars.

The instructions provide that cafe-observation cars

count as diners and that the inside cleaning cost shall be divided so that 60 per cent goes to account 441 and 40 per cent to account 402, this being based on average dimensions. A division of the charges for inside cleaning of observation sleepers provides for 30 per cent against account 402 and 70 per cent against 403. Charges for business cars depend upon the account of superintendence to which the officers' pay is charged. Charges for all other work on ordinary cars go to account 402.

It might appear that this form is too much in detail, but it is as yet an experiment and is lined up something in the same manner as we handle enginehouse expense. It is possible to make an entry of all operations each day in the month and then to use the same form for a monthly summary of the system. The summary at once gives us the total charge against the various accounts for cleaning cars and when the difference between the direct charge and the total charge as made by the accountant is too great, a further analysis is made to determine the reason. This form covers both labor and material, but does not provide for the usual overheads allocated by the accountant, such as store expense, shop expense, power plant distribution, bills, vouchers, etc. This is merely another illustration of intensive supervision of a certain class of work which cannot be fully controlled by other means.

Hiring men

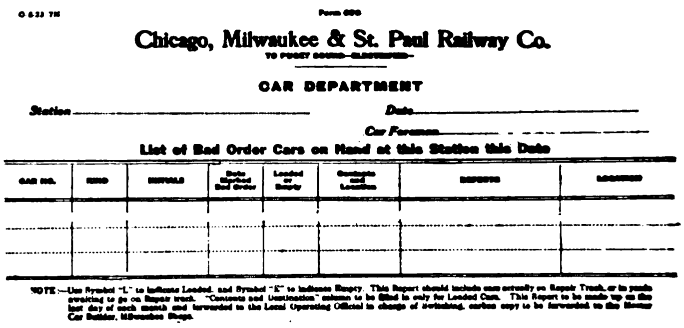
The personnel, comprising labor forces, reflects the intelligence exemplified by the employing officer when selecting new men for the service. In some cases there are periods where he may be restricted from making his judgment effective in the selection of his men, such as we witnessed during the late war when the labor shortage was tremendous and we were compelled, in many instances, to accept men who, under ordinary circumstances, would not meet the requirements. There are other times such as when forces are to be increased immediately for emergency service. This causes the average foreman to overlook the importance of knowing what kind of a man he is hiring. In every instance, where conditions will permit, the objective should be to secure the best available talent. The management must always have this thought in mind when issuing instructions to increase forces. Much can be accomplished, where large numbers of men are employed, by arranging for permanent forces, which results in steady employment to a sufficient number of men to take care of the service adequately. Emergency cases and fluctuations in business can be taken care of by temporary forces, and, if hired as such, it will give the employing officer an opportunity of selecting the best material to be assigned to the regular forces when vacancies occur.

Advancement of men

Proper care having been taken in selecting men for the service, it then becomes important that they receive the right training so as to develop whatever natural qualifications they may have for future advancement. Car foremen who are alert will quickly discover these traits and will endeavor to perfect their development, resulting in highly competent men being available for positions that require special skill or unusual attention on the part of the workmen. Such men should gradually be worked into the organization in the various positions for which their natural qualifications adapt them.

The great need in industry today is to provide employment that has an incentive for the employee voluntarily to do his utmost instead of being merely on the job. In many instances large employers have, at very heavy expense, provided departments to carry out well planned activities of interest to the welfare of their employees and often the results have proved a good investment. These plans are adaptable where the points of employment are confined to comparatively small territory. On railroads, employment is maintained every hour in the day, each day in the year, over thousands of miles, covering in many instances several states, making it practically impossible to follow such a plan, even though it were adapted to the needs. Therefore, of necessity, use should be made of other methods so that the average man will aspire to do his utmost in the interest of the service. To bring this about, it has been suggested that the following outline be striven for: (1) steady employment; (2) clean and sanitary housing conditions; (3) educational facilities; (4) a correct and complete understanding of company objectives.

The proper cultivation of human relations is equally important and mutually desirable in providing an incentive for employees to advance in the service. Every officer should feel that he really exemplifies the spirit in which the management is to be accepted by the rank and file. The foreman, in this connection, by his every act, reflects the policy and desires of the management, and, if they are cordially and humanly applied, it will establish


Chicago, Milwaukee & St. Paul Railway Co.

CAR DEPARTMENT

Station ________ Date ________

Car Foreman ________

List of Bad Order Cars on Hand at this Station this Date

Monthly report of bad order cars on hand

a mutual understanding that develops conditions which instill in the hearts and minds of the men the desire to succeed.

Too often supervisors, and managements as well, lose sight of these essentials which are so eminently necessary to enlist the undivided support and loyal feeling which results in the men liking their work. Once this is accomplished, the way is cleared to perfect an organization among the men, who can function in units, that will provide successful accomplishment. Capable foremen readily acquire the ability to observe men who have this incentive and who, by their efforts, show distinct evidence of being willing and able to secure greater knowledge of the service and assume the added responsibilities involved in the discharge of the duties in each instance where men are advanced to more important positions. Men of this caliber must always be kept in mind and properly trained so that, eventually, they will be able to understand the fundamentals in connection with handling men, and, when vacancies in supervisory positions occur, they should be filled by those whose service merits such promotion. If properly handled, advancement will generally meet with the approval of the rank and file, and be further evidence that there exists an opportunity for them to do likewise, if they will fit themselves and be ready, at all times, to meet service requirements.

Discipline

The administration of discipline is in itself an act of judgment on the part of the management. No well directed property can function efficiently until the subject of discipline has been thoroughly studied and a definite

policy inaugurated, because discipline can rightfully be construed as constructive criticism. Each property has its individual problems to meet and in applying discipline to employees it should be done with a sense of justice that will be eminently apparent to those involved. Sentiment and personal favors must be entirely eliminated. Honesty, and a willingness to define the facts, should at all times prevail in order to eliminate the greatest evil in the application of discipline, which is discrimination. It is practically impossible to apply constructive discipline in any line of industry where there is a large labor turnover.

Foremen are apt to apply discipline under pressure by removing men from service for causes which when investigated are not substantiated by fact, resulting in their judgment having to be superseded by higher authority, and the employees involved returned to service. Action of this kind often causes the foreman to feel that he has not been properly supported, resulting in his becoming indifferent as to the action necessary in subsequent cases. Care should be exercised to impress each supervisor with the necessity of applying the principles above referred to in each case and profit by the judgment of his superiors because the details differ materially in almost every case where discipline should be applied. On the other hand, when cases are appealed to higher authority, decision must be rendered in support of the foreman where the facts and policy of the management warrant the action taken. Then if leniency is to be applied, the employee involved should so understand and the foreman be informed so that he will appreciate his duty when other or similar cases arise.

If these few facts in connection with discipline are truly observed and applied in harmony with existing conditions, a reduction in labor turnover will be readily evidenced. Close observers realize the tremendous expense, many times avoidable, due to the unnecessary changing of labor forces. If an employee is to be dismissed, it should be apparent that the service is thereby benefited. Very frequently employees are taken out of service and the new men assigned prove inferior, which clearly indicates that it would be an advantage to the railroad to have kept the employee in service, especially if a method could be applied that would eliminate any undesirable characteristics that he may have acquired. In this respect there is an element worthy of consideration. We appreciate, I am sure, that there are men who are objectionable and a detriment, and of course they should in some way be dealt with and definitely removed, care being taken that they do not re-enter the service at some other point without satisfying the management of their intention and desire to function so that their employment will be acceptable and of interest to the service. Discipline resolves itself into a feature of management, which must be comprehended, but never compromised.

Conclusion

In closing, allow me to suggest a few seemingly important items, as a matter of illustration, to indicate the meaning of effective car department service and which embrace:

(A) An organization with fixed ideals of attainment, working together towards the accomplishment of that end and with the right sense and exercise of the importance of individual initiative and responsibility.

(B) The proper contribution towards safe and prompt train performance by obtaining maximum mileage per car per year with a minimum of detention en route due to inspection, physical defects or damage to lading, and at a minimum cost.

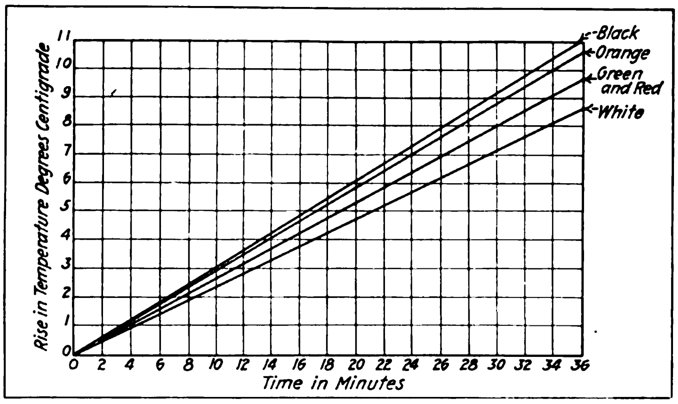
An experiment to reduce refrigeration losses

By Henry A. Gardner
Institute of Paint & Varnish Research Laboratories, Washington, D. C.

During the summer months, surfaces painted in dark colors rapidly absorb the heat rays and become very hot. When white paints are used, the painted surfaces are slow to absorb the heat rays and, consequently, will remain several degrees cooler. An application of this principle might well be made to conserve ice and keep refrigerator cars at a temperature sufficiently low to preserve the perishable foodstuffs for a longer period of time. At the pesent time refrigerator cars are generally painted an orange color which rapidly becomes warm and transfers its heat to the various compartments. The result is a loss of ice and foodstuffs. This is indicated by the results of some of the experiments recently conducted at the Paint and Varnish Research Laboratory at Washington, D. C.

Method of making tests

Experimental carriers were constructed of friction top containers. A double wall effect was obtained by placing a pint container inside of a quart container. The space



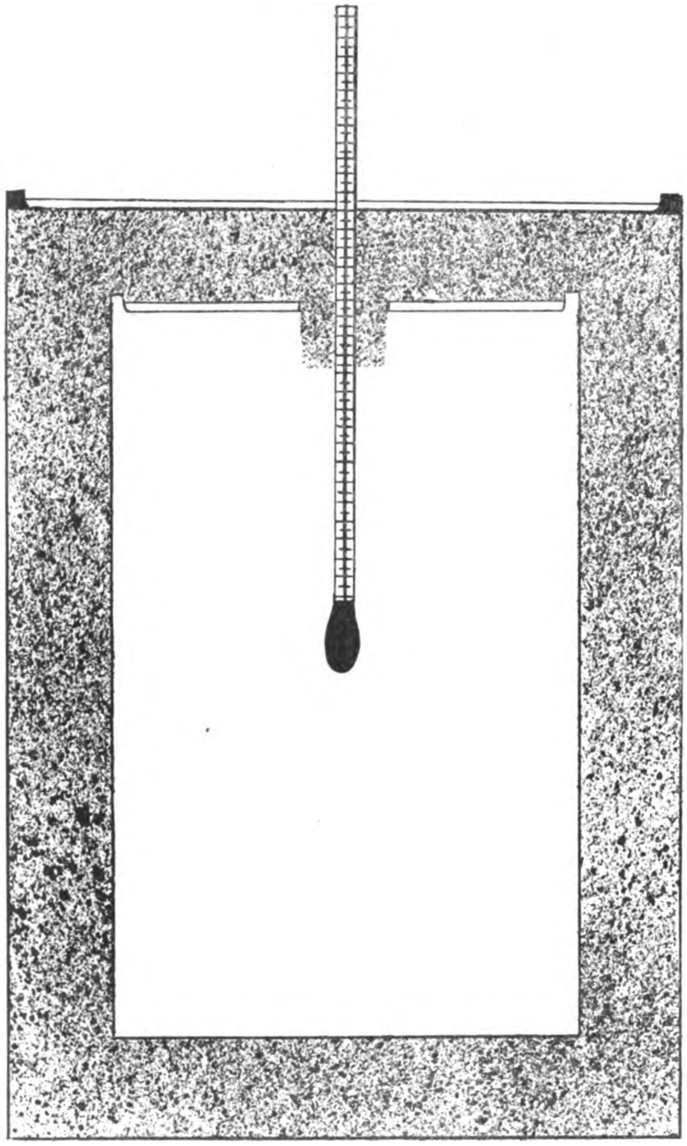
Graphic representation of the rise in temperature of different colors of paint when exposed to the sun

between was filled in with ground cork about 1/16 in. to 1/8 in. in diameter. The exterior surface of the outer container was painted two coats, each with a different color. Several containers were thus prepared and filled at the same time with a low temperature refrigerating fluid. The liquid used in one instance was ice water, and a solution of solid carbon dioxide gas in acetone was used in the other instance, which had a temperature of 40 deg. C. Closely comparable results were obtained with these two liquids. Cracked ice was also experimented with, but it was found difficult to obtain uniform temperatures in each can because of the difficulty of transferring the ice in exactly equal quantities without a loss of temperature.

After placing the liquids in the inner cans, the covers, which were provided with stoppers and thermometers, were adjusted and a layer of cork spread over the upper surface after which the outer containers were sealed at the top. The row of vari-colored containers was placed out of doors in the sun and thermometric readings were made once a minute. At the end of 30 min. the black cans could not be handled because of their high temperature of 140 deg. F. The white cans could be handled

comfortably, indicating a very much lower temperature. Later experiments with white metallic pigment powders indicated that they do not give as efficient results as the white paint, but superior results to most tinted or colored paints.

The rapid transfer of heat apparently took place from the outer can through the layer of cork and air insulating space, and then through the inner can into the liquid. This transfer of heat is very rapid, as is shown by the temperatures recorded at the end of 30 min. It is conceivable that much greater differences might be shown at the end of six or eight hours time on a freight car in



Arrangement of apparatus for determining refrigeration losses

a sunny yard or even in transit. Convection might, however, play an important part in the latter instance. The results obtained with these tests would suggest the use of white or light tints rather than the darker colors on refrigerator cars.

Through the use of test fences out in the open, the value of paint as a preservative has been proved and now through this latest experiment a new use of the right kind of paint to reduce to a minimum refrigeration losses in freight cars has been shown.

Proper application of paint

In line with this research work on the painting of refrigerator cars is the application of the paint. Where it formerly took a man at least a day to apply one coat of paint to a freight car, it now takes but an hour or two provided the principle of atomization or spraying is used. The paint gun, after much experimenting, has been brought from a crude, imperfect tool to a simple, highly effective device. Painting by this mechanical method can be done in a fraction of the time required by hand brushing, the paint is spread more uniformly, and the coating of paint, so important to the refrigeration car, is heavier and more durable.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Information to be specified in case of replaced springs

The Erie made repairs to C.S.N.O. & P. car No. 122033, which is the property of the Gulf Coast Lines. Among the items of repairs made was included the replacing of one D.C. draft spring on account of being broken. The Gulf Coast Lines returned this repair card to the Erie calling attention to the fact that the repair card did not show that both coils of the draft spring were broken and referred to the interpretation of Rule 8 as authority for request that the charge be reduced to cover the outside coil only. The Erie returned the repair card and refused to reduce the charge as requested, claiming that as the repair card and original record of repairs showed "D. C. Spring" applied on account of being broken, the charge for both coils was correct.

The Arbitration Committee rendered a decision to the effect that: "In order to justify a charge for a double coil spring, it is necessary that the original record of repairs, as well as billing repair card, show that each coil was defective. This information must not be assumed."—*Case No.* 1315, *Gulf Coast Lines vs. Erie.*

Responsibility for car damaged in loading

Buffalo & Susquehanna steel gondola No. 12258 was delivered by the Delaware, Lackawanna & Western to the South Buffalo to fill an order to load pig iron to a point on or via the D., L. & W., the order having been placed by the Rogers-Brown Iron Company with the South Buffalo. In the process of loading this car with pig iron, the body of the car buckled when partly loaded and settled down and the car body was damaged beyond repair. The owner demanded settlement under Rule 113. The South Buffalo contended, on the other hand, that Rule 120 was applicable to the case. The car owner stated that the damage to the car was originally properly reported as a responsibility of the handling line and that the facts in the case did not justify the South Buffalo in changing its report to make the case come under the Rule 120. The owner further stated that if the car had been in the condition claimed by the South Buffalo in its last report, it would not have been accepted loaded by three foreign roads and empty by the same number of roads, including the South Buffalo. It was contended that if the car was not in fit condition for loading it should have been reported, in accordance with Rule 120, by the South Buffalo, before being delivered to the shipper, in order to give the owner an opportunity to inspect the car, and not after

its destruction when an inspection could not possibly reveal the prior condition of the car. The South Buffalo stated that after the failure it was determined that the floor plates were so badly corroded and rusted away, and the center construction in such a weakened condition that the car was no longer fit to carry its marked capacity. It was further stated that this condition was not evident nor would it be on usual junction inspection, nor was it known to the Iron Company. The handling line contended that it must accept the owner's statement marked on the car that it will safely carry a certain load, that failure is the inevitable result of such weakness as developed in this case unless the owner takes the precaution to reduce the loading or to replace the parts which deterioration has rendered unfit for service.

The Arbitration Committee, in a decision rendered February 15, 1924, sustained the contentions of the South Buffalo in that this car was properly subject for disposition under Rule 120.—*Case No. 1317, Buffalo & Susquehanna vs. South Buffalo.*

Narrow gage refrigerator cars for the D. & R. G. W.

TWELVE narrow gage refrigerator cars were built at the Alamosa shops of the Denver & Rio Grande Western in September, 1924, with the object of making them large enough to take a minimum standard gage car load, as most of the produce shipped on the narrow gage has to be transferred to standard gage cars to reach its destination. The trucks on these cars are placed 4 ft. 3 in. from the ends, on account of the numerous sharp curves.

The cars are of wood construction throughout and weigh 34,300 lb. with a capacity of 50,000 lb. The underframe is made up of 5-in. by 9-in. side sills, two 4-in. by 8 3/16-in. inter sills and two 5-in. by 8 3/16-in. center sills. The body bolsters are of cast steel. The walls consist of an inside lining 13/16 in. thick, one layer of 90-lb. paper, ½ in. Flaxlinum, 2 5/16 in. air space, ½ in. Flaxlinum, one layer of 90-lb. paper and 13/16 in. siding. On account of the height of the car, the construction embodies only one belt rail.

The floor is made up of a 13/16-in. sub-floor, a ⅛-in. layer of Unarco waterproofing compound, 2 in. of cork, a ⅛-in. layer of Unarco compound and a 7¾-in. ship lap top flooring.

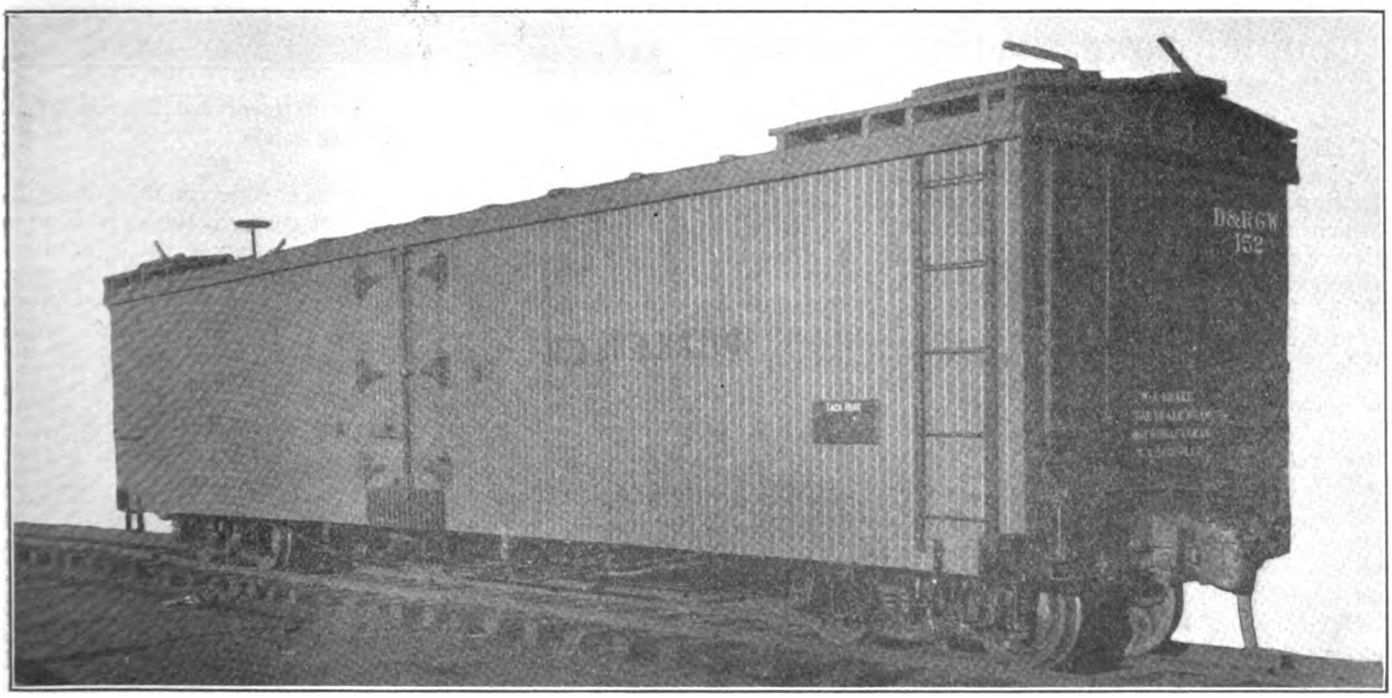
The ceiling is insulated with 1 in. of Flaxlinum laid between the carlines. A Murphy XLA metal roof is used.

The doors are equipped with Ureco self-locking hinges and Miner refrigerator door fixtures. Imperial Type "B" uncoupling rigging and Economy steel ladders are applied.

The dimensions of the car are as follows:

Length between pulling faces of couplers	42 ft. 10½ in.
Length over end sills	40 ft. 0 in.
Width of car, outside	8 ft. ⅝ in.
Inside length between bulkheads	33 ft. 2 in.
Inside width	7 ft. 2¾ in.
Inside height	6 ft. 4 in.

The bulkheads are stationary and insulated with 1 in. Flaxlinum. Tyler bunker netting is used in the ice bunkers. The bulkheads, bunkers, hatch covers, plugs and platforms follow the design of the U. S. standard cars.



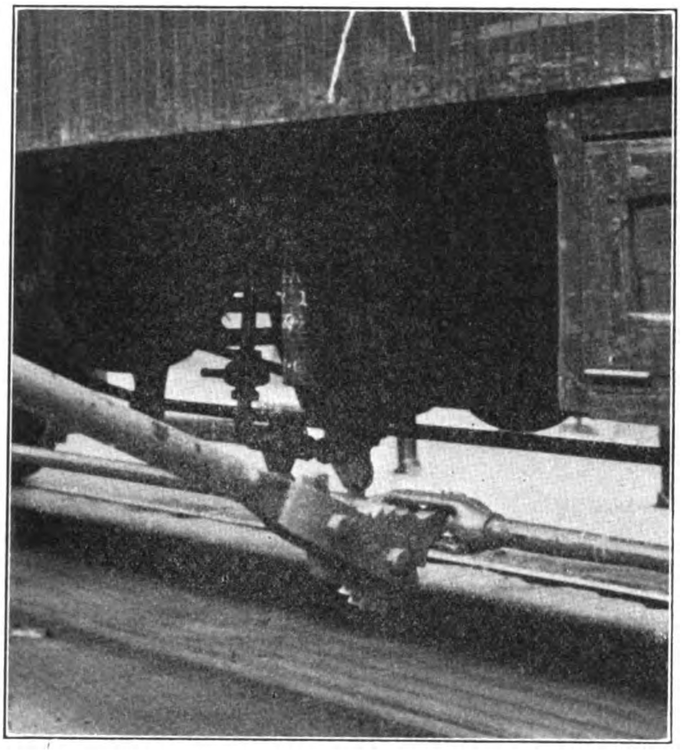
Narrow gage refrigerator car which will take minimum standard gage car load

Ratchet wrench for passenger car truss rods

IN the process of tightening up passenger car truss rods it is not unusual to find that battery boxes, air reservoirs and other equipment interferes with the free use of the ordinary pin bar used for this work. There is in use at the Billerica shops of the Boston & Maine a ratchet wrench which can be readily used where the space is limited.

With a wrench of this kind the buckle can be turned completely around with only a 6-in. space to turn the wrench. The stub end of the wrench is inserted in the buckle and is prevented from slipping out by a cotter key placed in a hole at the end of the stub. The ratchet may be set at a different angle as the buckle is turned around.

There can be slipped over the purposely short, 1-in. diameter lever end of the wrench a long piece of pipe by which a greater leverage may be obtained. This appliance can



Truss rod ratchet wrench adaptable for use in a limited space

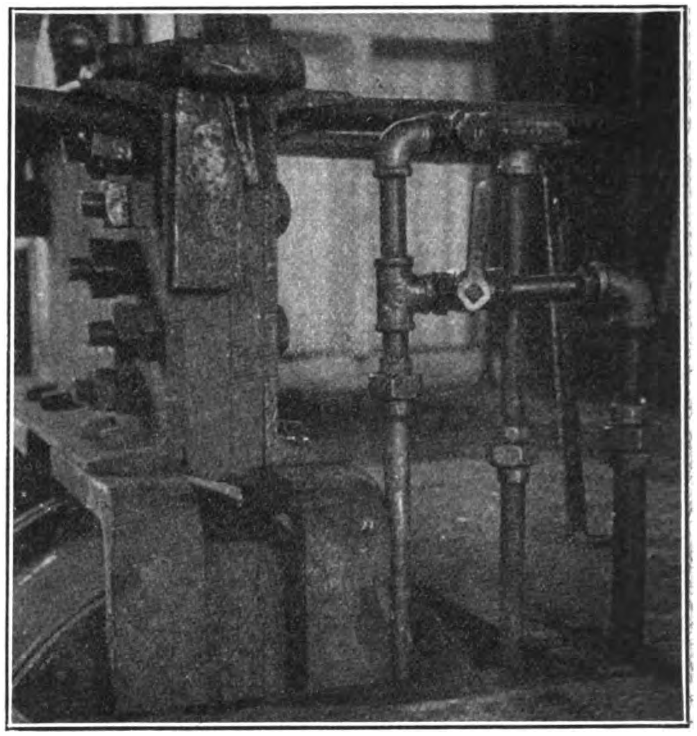
be readily made by any blacksmith and, with a small amount of machine work, there is produced a tool which will prove very valuable in tight places.

Coupler yoke riveting machine

By G. Charles Hoey

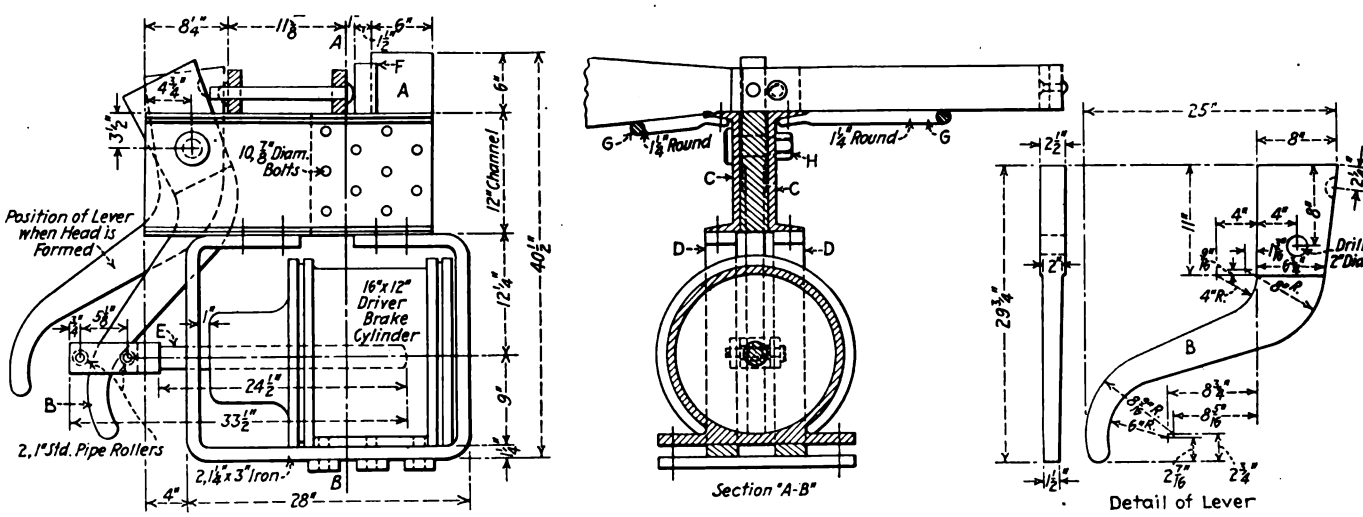
THE machine shown in the drawing was devised by a car foreman in order to facilitate the work of getting cars away from the rip track, a problem which he had had considerable difficulty in solving. The device consists essentially of an anvil block *A*, a lever *B*, a supporting frame *C*, two supporting brackets *D* and a 16-in. by 12-in. driver brake cylinder. The supporting frame *C* is constructed from two 12-in. structural channels 28⅜ in. long. The two supporting brackets *D*, are formed from 1¼-in. by 3-in. bar iron. A connecting yoke *E* is welded to the driver brake cylinder push rod. Filler blocks *F*, of varying thicknesses may be inserted in front of the anvil block *A* to suit the different size coupler yokes. The supporting arms *G* are made of 1¼-in. round bar iron, and are riveted to the flanges of the frame channels.

In applying the coupler yoke to the head, the coupler butt is placed in position in the yoke on the supporting arms *G*. The heated rivet is then slipped into place and the coupler and yoke is moved over until the rivet head is in position in front of the filler block *F*. Air is then admitted to the operating cylinder and as the air cylinder

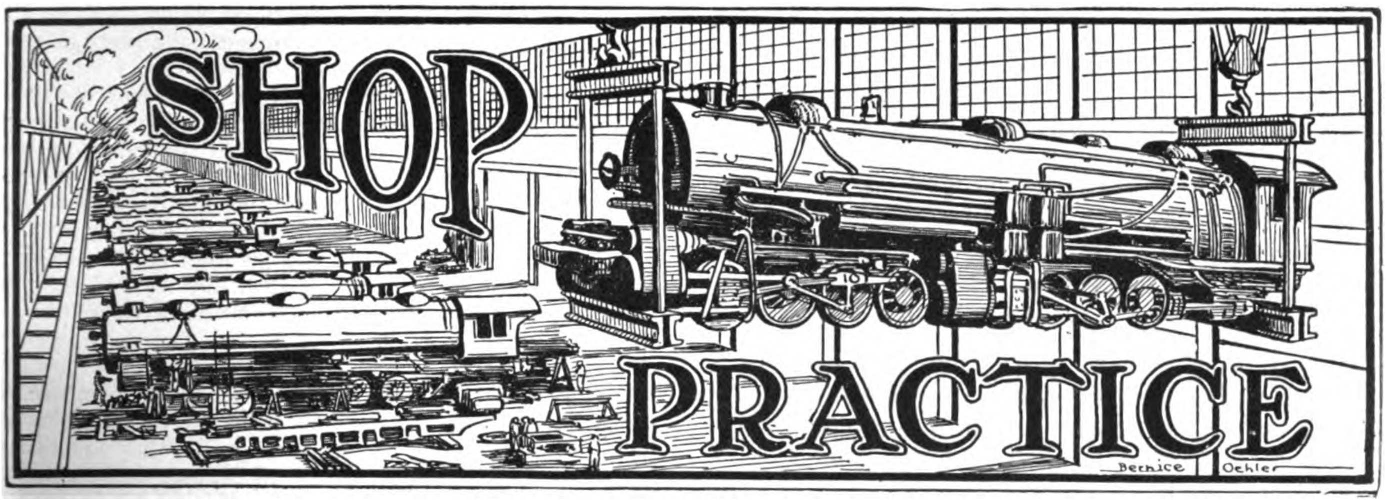


View showing the piping arrangement and location of the operating valves

piston moves forward, the back roller in the connecting rod jaw moves along the inner curve of the lever *B* which is pivoted on the pin *H*. This action of the lever drives down the protruding end of the heated rivet and the recess in the upper end of the lever *B* forms the head of the rivet. Upon releasing the air from the cylinder the spring forces the piston back into position.



Drawing showing the arrangement of the coupler yoke riveter



The heat treatment of spring steel

Knowledge of steel, temperature effect, quenching media and drawing or tempering essential

By J. E. Burns, Jr.
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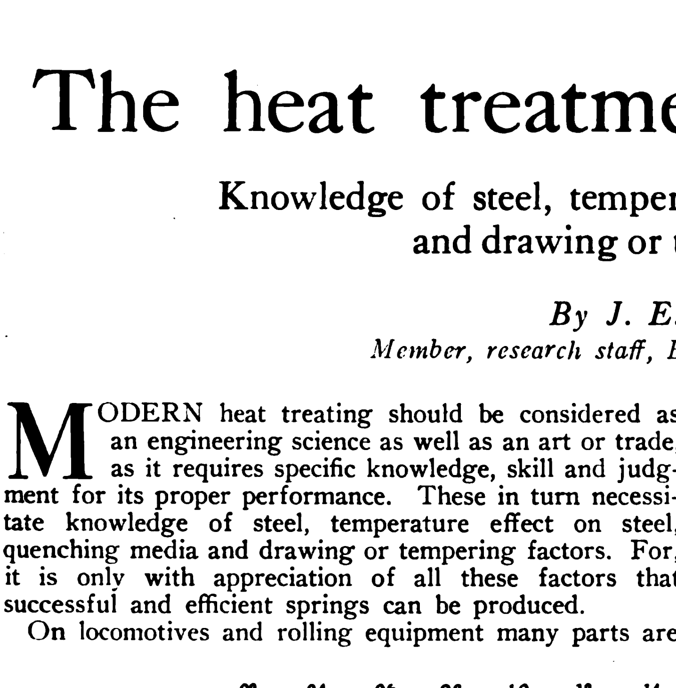
MODERN heat treating should be considered as an engineering science as well as an art or trade, as it requires specific knowledge, skill and judgment for its proper performance. These in turn necessitate knowledge of steel, temperature effect on steel, quenching media and drawing or tempering factors. For, it is only with appreciation of all these factors that successful and efficient springs can be produced.

On locomotives and rolling equipment many parts are used, all having a more or less severe duty to perform and requiring steels possessing various degrees of strength, toughness, resilience, endurance, shock resisting and wearing or abrasive qualities. These various combinations of static and dynamic strength are obtained by adjusting and correlating both the chemical composition and heat treatment of the steel. Certain chemical components intensify the static, others the dynamic qualities.



Graphic presentation of the per cent elongation and tensile strength of steel with various carbon contents

Springs are subjected in service to repeated stresses. These repeated stresses upon steel cause a gradual disturbance of the structure and its component particles, which greatly weakens the material and is called fatigue. These stresses causing such fatigue can be broadly classed as repeated static and acceleration stresses, and it is necessary that a knowledge of the capacity of the steel best able to resist such action should be used and should serve as a basis for its selection.

A steel of the following constituents best meets these requirements (commercial alloys will not be discussed here as their use is not general in railroad work):

Carbon	.90 to 1.05 per cent
Manganese	.25 to 0.50 per cent
Phosphorus	.04 per cent max.
Sulphur	.05 per cent max.
Silicon	.04 per cent max.

Structure of steel

Carbon steel is an alloy, but should not be confused with the term commercial alloys that are now available. Its principal and essential chemical constituents are carbon and iron. With these are usually certain impurities such as phosphorus, sulphur, silicon and manganese.

Of the elements or constituents which go to make up ordinary carbon steels, the impurities manganese, phosphorus, sulphur and silicon approximate one per cent. The carbon will vary from a few hundredths of one per cent to about two per cent and the balance will be iron.

Steel is not a single substance like copper or gold, but is made up of mineral grains, corresponding to the quartz, mica and feldspar of granite. In steels which have cooled slowly from a high temperature, we have ferrite (iron), cementite (carbon) and pearlite (carbon and iron). And just as the relative amounts of quartz, mica and feldspar may vary in the rocks of granite so will the relative proportion of ferrite, cementite and pearlite vary in different steels according to their specific chemical composition.

In steel cooled from high temperatures the carbon is always combined with a definite amount of iron, forming a carbide of iron. This compound consists of 6.6 per

cent carbon and 93.4 per cent iron, and is microscopically known as Cementite. The balance is iron and known as Ferrite.

Cooling at a moderate rate from a red heat, this cementite will form a mechanical mixture with a definite amount of ferrite, the result of which will approximate .9 per cent of carbon and is called Pearlite. Pearlite is regarded as a separate and distinct constituent of steel, as it forms distinct grains, when present in any appreciable quantity, and always contains this definite amount of carbon.

From this it will be seen that a steel containing .9 per cent carbon will consist entirely of pearlite. Such steels are known as eutectoid steels and that ratio of carbon as the eutectoid ratio. In other words, this is the same character of steel as used in the manufacture of both elliptic and coil type springs.

Ferrite is soft, ductile and relatively weak. It has a tensile strength of approximately 40,000 to 50,000 lb. per sq. in., and has no hardening power, as applicable to industry. It is magnetic and has a high electric conductivity.

Pearlite has a tensile strength of approximately 125,000 to 130,000 lb. per sq. in. with elongation of about 10 per cent in 2 in.

The properties of cementite are very little known with the exception of its great hardness and brittleness; it probably does not have a tensile strength over 5,000 lb. per sq. in.

Static strength

We may now sum up these facts in their relation to the static strength of slowly cooled steels as follows:

Free ferrite has a maximum tensile strength with maximum ductility.

Pearlite a maximum tensile strength with low ductility.

Free cementite confers added hardness and brittleness, with a consequent lowering of the tensile strength.

Thus, it is apparent by increasing the amount of Pearlite in steel we increase the static strength but with a corresponding decrease in ductility.

Heat treatment

Heat treatment in general consists of regulating or changing the structure of steel by various methods of heating and cooling. The nature of steel is complex, and its structure may be modified or completely changed by various degrees of temperature, all of which take place in steel in its solid form. These changes take place at temperatures known as *critical ranges.*

They are denoted by the letter A followed by the letter c signifying heating or the letter r signifying cooling. These signs Ac or Ar are further modified by the numerals 1, 2 or 3, indicating the particular point referred to. Thus, Ac 1 would mean the first critical range passed upon heating.

In considering this diagram let us devote our attention to the steel in question, spring steel, .90 to 1.00 per cent carbon, in its normal condition resulting from slow cooling, or in the annealed state, in that it consists of .90 per cent carbon consisting entirely of Pearlite.

Let us first consider the influence of temperature on the constituent Pearlite while passing through the Ac 1-2-3 range. Practically no change in this constituent occurs during heating until a temperature corresponding to the critical range is reached, which in this case is approximately 1,340 deg. to 1,400 deg. F. (727 deg. to 760 deg. C.).

In passing through this critical range there is a complete change in the nature and structure of the Pearlite. It is converted into a new constituent with new characteristics. This is technically known under the term solid solution, microscopically called Austenite. This new constituent, save that it is a solid and not a liquid, has all the properties of a liquid solution. Its original components are merged into a single entity, giving a complete indefiniteness of composition with entirely new characteristics. When quenched in oil at a temperature of 1,340 deg. F. and not over 1,400 deg. F., it passes through a transition and is known microscopically as Martensite. In spring steel Austenite as such cannot be retained by the ordinary methods of oil quenching but changes into Martensite.

Spring steel when slowly cooled from above this critical range of 1,340 deg. F. passes out of solution as Austenite and takes the original Pearlite structure. This is important to note as this fact which is little appreciated is the cause for many spring failures which will be explained in a discussion of quenching media.

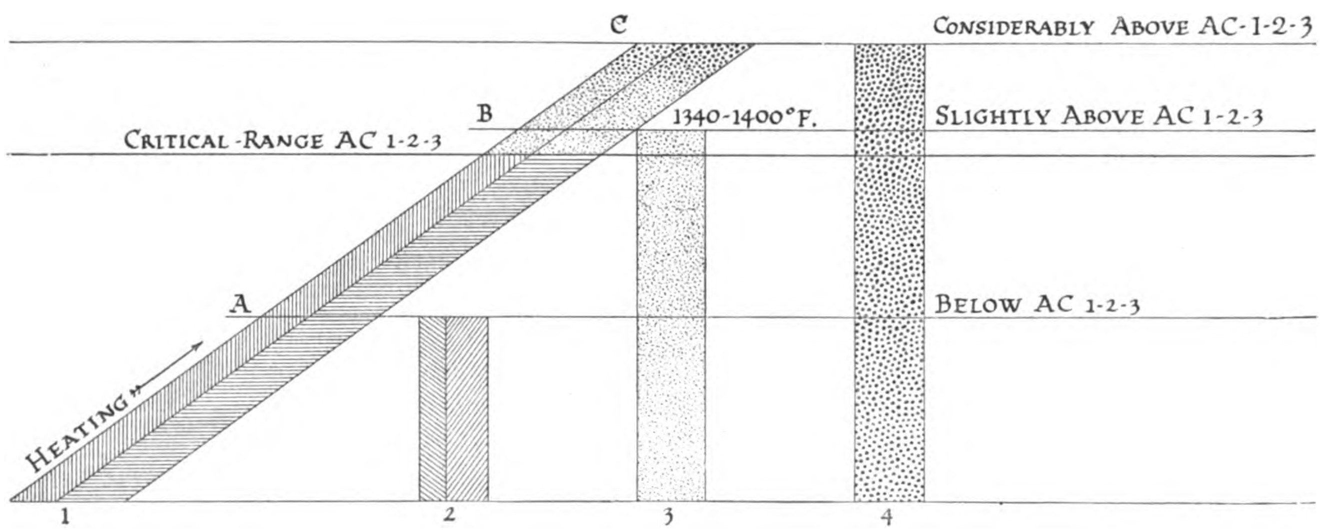


Diagram representing the structural changes which take place in Pearlitic spring steel as it is progressively heated through and beyond the critical range

Refinement and grain size beyond Ac 1-2-3

At slightly above the critical point in .90 to 1.00 per cent steel (spring steel) the original Pearlite grains are changed to Austenite as previously explained and

will possess that maximum refinement which the formation of Austenite can impart. As the temperature is progressively raised above the critical 1,340 deg. to 1,400 deg. F., a gradual coarsening of the Austenite grains occurs with attending weakness in the oil quenched spring.

A very clear understanding of these principles must be had as it is a lack of understanding of these facts that is the cause of many spring failures.

Hardening

The operation of hardening spring steel involves two specific operations of change in temperature, heating and cooling. The function of heating is first to obtain the best refinement, and secondly to obtain the formation of Austenite. The steel must then be held in this condition by very rapid cooling in oil. Associated with both the heating and quenching there must be as great a degree of uniformity as is possible. This is important to note.

Spring steel when properly hardened should show no trace of the original Pearlite structure, coarse grain size, or any other peculiarities of untreated steel. If such is present in the hardened steel it goes to prove the operation was not properly carried out. If the structure of the Austenite has not been suitably developed by the

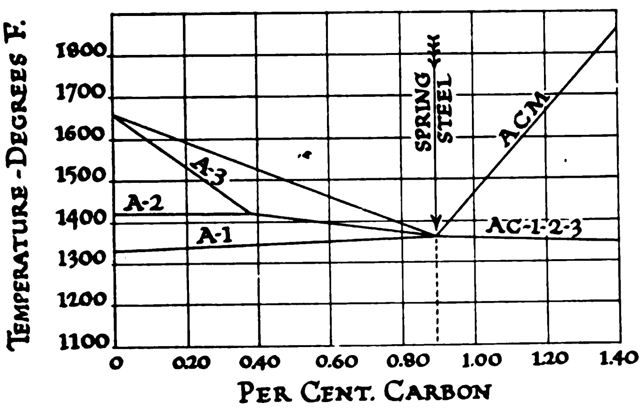


Diagram showing various critical ranges of steel.

heating operation, it will not be altered for the better by subsequent quenching. The most any quenching media can do is to retain the characteristics which the heating operation develops.

Column 1 in the above diagram represents a normal .90 to 1.00 per cent carbon pearlitic spring steel and the structural changes taking place in that steel as it is progressively heated through and beyond the critical range Ac 1-2-3, and we will assume that the structure and microscopic constituents obtained by heating to various temperatures, such as *A* to *C*, may be retained by use of a proper quenching medium as illustrated by columns 2 to 4.

By heating to temperature *A*, under the critical range Ac 1-2-3, 1,340 deg. to 1,400 deg. F., no change will be produced in the original steel, which consists of Pearlite. The quenching likewise will produce no change, as shown in column 2. Heating to slightly over the critical Ac 1-2-3, 1,340 deg. to 1,400 deg. F. will change the Pearlite to solid solution Austenite if held a sufficient time to effect complete diffusion. This will entirely refine the steel, giving it the finest grain size possible.

Quenching column 3 will retain the condition in the form of Martensite, developing the maximum hardness possible. Heating to temperature *C* considerably over that of the upper critical range will tend to increase the grain size, and quenching column 4 will retain this condition and consequently developing a brittle steel.

Heating for hardening of spring steel should be slow, uniform and thorough and to the lowest temperature which will give the desired result. This is due to the setting up of stress which follows rapid cooling. Overheating has been the cause of over 80 per cent of the spring failures checked by the writer on complaints of bad steel. Both theory and practice support the old rule that "The lowest heat which will give the desired results is the best."

Quenching media

The primary consideration of an oil bath for quenching spring steel is the rapidity with which the heat is removed. This property of transference or conductivity is most important. Its ability to arrest Austenite in its Martensitic form is its outstanding attribute.

Animal and vegetable oils will harden satisfactorily when fresh, or when first used. Upon continued use the quenching speed lessens. Any liquid which will not ignite will harden partially. Originally the animal and vegetable oils were employed exclusively for quenching, upon the theory that these two groups of oils possess a much higher flash and fire than mineral oils, but as the temperature of the steel was always at least 1,000 deg. F. higher than the ignition point of any oil, it was afterwards discovered that the ignition or flash point was of no consequence, provided sufficient volume and circulating facilities were used.

It is a well established fact that all animal and vegetable oils oxidize when continually subjected to high temperatures, developing a change in viscosity and a corresponding change in the quenching speed. This change in quenching speed causes unsatisfactory hardening, as the Austenite developed in heating from 1,340 to 1,400 deg. F. is not arrested in the desirable form of Martensite. It shows a semi-Mratensitic Pearlitic structure. This structure does not develop the physical properties necessary to long spring life.

Petroleum oils are peculiar in the fact that they are composed of an innumerable number of hydro-carbons of different boiling points. These hydro-carbons distill out gaseous vapors in the order of their respective boiling points, causing a constant change in viscosity upon continued use. This change in viscosity brings about a similar condition as noted with respect to animal and vegetable oils, and should be avoided for the same reasons in spring work.

Investigation into other quenching media indicates that oils distilled from Degras (wool grease) approach nearest the ideal. These products have all the desirable characteristics, with but few of the undesirable. The quenching speed is more rapid and uniform over a greater range of temperature, the viscosity is constant, the oils do not distill, and while of a hydro-carbon nature, they will saponify under pressure. The use of such a product, with the steel and temperature factors correct, insures the desired development of the microscopic constituent Martensite in the hardening operation.

The impression exists that flash and fire points are essential characteristics of desirable quenching media. Investigation into this subject reveals the fact that, as no oxygen gets into the oil below the surface, and that so long as the oil on the surface which is exposed to the air, does not reach the temperature of its fire test, there can be no ignition, no matter how much heat is introduced into the oil under the surface. For such reasons, flash and fire values are not of importance.

Tempering and drawing

The prevalent practice in the past has been to perform the drawing or tempering operation by the flash back

method which has been productive of very unsatisfactory results. Absolute uniformity of the drawing temperature should be applied in the drawing back operation which cannot be accomplished by the flash back method or by drawing in furnace atmosphere at comparatively low temperature.

The most successful method of performing this operation is the use of a salt bath. A high temperature thermometer placed in the molten salt will indicate the desired temperature for the spring to be drawn. The springs can then be emerged into the bath and when the bath attains the predetermined temperature they can then be withdrawn with the assurance that the application of temperature has been absolutely uniform throughout. The result is a complete spring with the highest physical properties possible to develop in consideration of the character of steel used in its manufacture.

When a piece of spring steel is heated to slightly above its critical point—Ac 1-2-3, 1,340 deg. to 1,400 deg. F.—and quenched with a satisfactory quenching oil the necessary initial hardness is developed. But the inevitable stresses caused by rapid cooling render spring steel unsatisfactory for service in this condition. In order to render spring steel ready for service a further transition is necessary. This is brought about by further application of heat, which will now accomplish two things. It will relieve the hardening strains and so permit the transition of the spring steel from its Martensitic or hardened form to that known as Troostite. By properly adjusting the temperature of this reheating process the desired stage in the Martensitic Troostictic transition may be obtained. This stage is developed in spring steel between 650 deg. to 750 deg. F. (343 deg. to 399 deg. C.).

If spring steel has been properly heated and quenched so that it is composed of Martensite without grain growth developing the highest initial hardness, Troostite will begin to form at approximately 400 deg. F. (204 deg. C.). As the tempering or drawing temperature is progressively increased, the Troostite increases in amount until 750 deg. F. at which point it begins a further transition into Sorbite. To carry spring steel over into Sorbite causes set; to neglect the development of Troostite encourages fracture provided the heating and quenching operation has been carried out to that point.

Hence, we arrive at the necessity for the control of temperature on the drawing or tempering operation. The old flash back method proved unsatisfactory due to the inability of the operator to control temperature. Dry heat, such as was and is used, has a very low heat conductivity. Temperatures between 680 deg. to 750 deg. F. cannot be indicated by sight and recording instruments are not satisfactory for this purpose.

When the spring leaves are introduced into the bath the temperature falls and when it assumes the pre-determined temperature the leaves can then be removed and quenched in water, the water bath being used only to wash the excess salt adhering to the leaves.

By maintaining the bath at the proper temperature there can be no over-heating, developing Sorbite. The heat must penetrate all parts of the steel alike and the personal equation is as nearly eliminated as is possible. This method has the further advantage of cutting down labor costs and increasing output, since a number of leaves may be heated at the same time.

Oftentimes what is known as initial set causes misunderstanding. Initial set is developed in all heat-treated work, due to lack of molecular cohesion, and allowances for this set should be made in setting springs of both the elliptic and coil type. If this is appreciated no springs need be rendered useless, due to permanent set. Coil springs that have taken a set should be heated to 1,600 deg. F. (871 deg. C.) and expanded approximately one-quarter to one-half inch above the specified height to allow for the initial set and then again be processed as described.

Springs when removed due to leaf failure by fracture should be dissembled and all leaves subjected to the same heat treatment as the untreated steel for the reason that the spring in service being subjected to repeated stresses has partially crystallized, causing an attendant weakened condition. The assembled spring then has all the physical characteristics of the new spring and should give the same life in service.

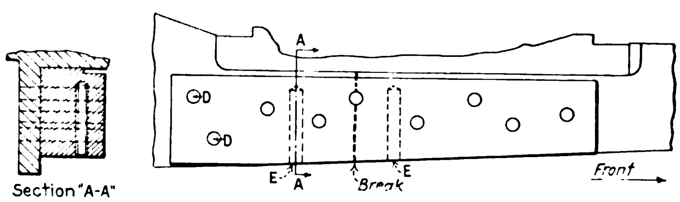
Forming operation

It is common practice to heat the leaf, form and quench it. It is impossible to produce a quality spring in this manner. The leaves should be heated to a forging heat, 1,600 deg to 1,650 deg. F. (871 deg. to 899 deg. C.), and formed. They should then be reheated to 1,340 deg. to 1,400 deg. F., quenched, reheated to 650 deg. to 750 deg. F. in a salt bath and then quenched in water. This practice might incur a slight additional expense in manufacturing but should be paid for many times by the increased life in service.

Temporary repairs to a one-piece locomotive frame

The splice illustrated in the sketch was used in repairing a broken one-piece frame on a 4-6-2 type locomotive. The break occurred a short distance back of the center of the cylinder bearing, being in contact with the cylinder casting at the top and running thence along the outside of the frame. Owing to the position of the break, and for other reasons, it was not considered advisable to weld the frame in place, but to try splicing with a heavy plate.

A piece of material of approximately half the thickness of the frame was forged and faced on one side to make a bearing against the frame. The four bolts ahead of the break, the one at the break, and the two to the rear were



The break occurred a short distance back of the center of the cylinder bearing

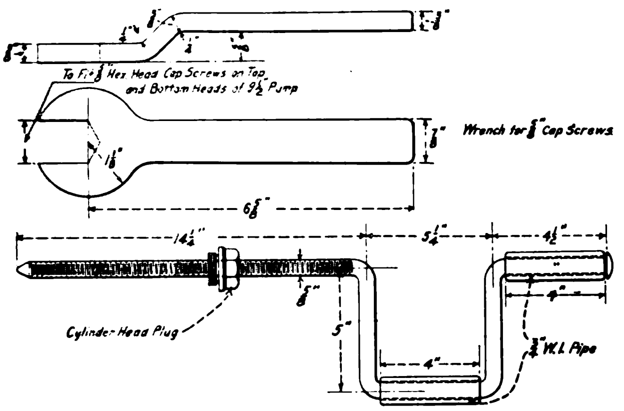
removed. The piece was laid out and drilled, with two extra holes added near the rear. These were later drilled through the frame making the arrangement as shown, with four holes on each side of the break. After the bolt holes were reamed and the bolts fitted, two holes were drilled, one forward and one back of the break, as shown at *E*. These were reamed and plugged, the center line of the plug being at the inner face of the plate at the bearing against the frame. The plugs acted as keys to overcome any possible shearing of the bolts. After they were driven slightly beyond the surface, the ends of the holes were closed over the plugs to prevent their dropping out in case the splice should work.

No trouble was experienced with the patch loosening after the locomotive was placed in service.

Device for forcing up pistons on air pumps

By E. A. Miller

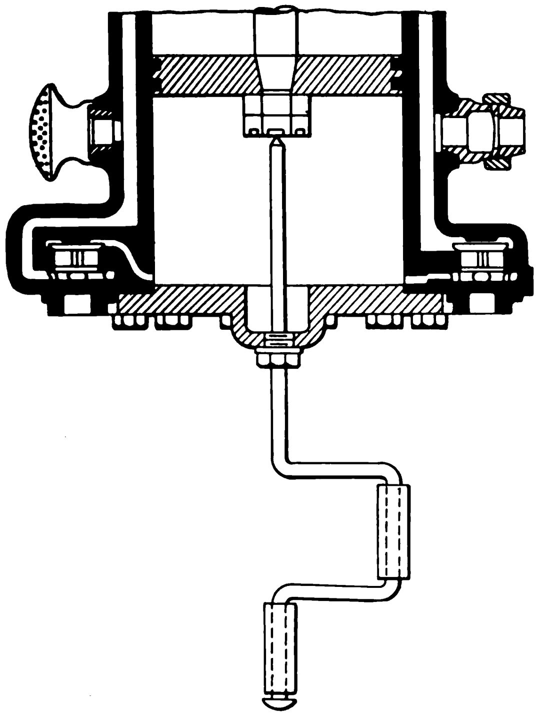
THE operation of removing the top head gaskets, reversing valves and rods from air pumps while on a locomotive is somewhat difficult. To do this it is necessary to remove the reversing valve stem which extends down into the piston rod



A device for facilitating the removal of top heads and gaskets from air pumps

which is drilled a certain distance from the upper end. This makes it necessary to force the pump pistons about half way up in the cylinder.

The device shown aids greatly in performing this work. It is made of 5/8-in. round iron or steel, threaded and bent.



Application of device for forcing up air pump pistons when removing top head or gasket

It is necessary to put the center handle on prior to making the final bends. A regular air cylinder head plug is drilled and tapped 5/8 in. to suit the threaded portion of the handle. The illustration shows the method of using the device to force up a piston. After the piston is once forced up it can be held there indefinitely. This is an improvement over the old method of pushing up the piston by putting an iron bar through the cylinder plug hole. If the friction of the piston rings and piston rod packing was not great enough, the pistons would settle back into place before the work on the pump could be completed.

Progress boards for the wheel gang

By J. Robert Phelps

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A BOARD kept at the crank pin and axle lathes, for following up the work on crank pins and axles is shown in Fig. 1. It shows the locomotive number and date of wheeling and what is to be made for it. It keeps the machinist informed as to what work is to be done next and, as he completes the job, he draws a circle around the item on the board, indicating the completion of that particular job.

Fig. 1—Progress board located at the crank pin and axle lathes

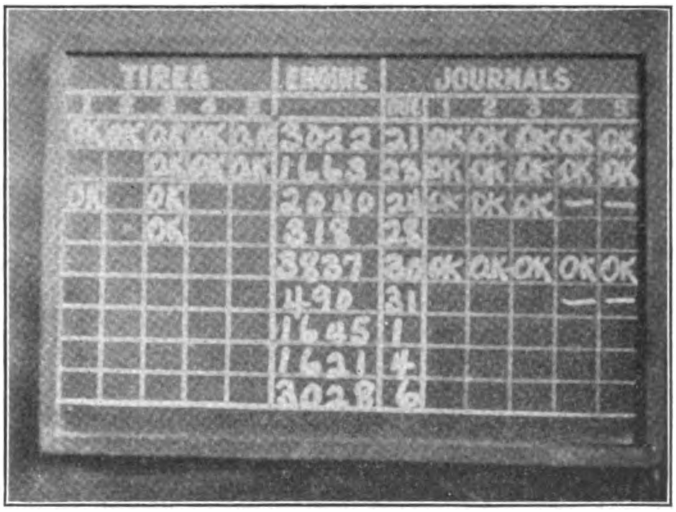


Fig. 2—Chart board which indicates the progress of the repairs to tires and journals

Fig. 2 applies in the same way to the turning of tires and journals. This arrangement helps to keep the foremen and the machinists posted as to what should be done next. For

example, all the tires may be turned for a locomotive except one pair, these being delayed because there are some broken spokes in a wheel which are being welded. Additional delays may be caused by the gas welders bringing a pair of wheel centers up to standard size, a journal waiting for a hub liner to be applied, or the store house slow in furnishing a main pin. The boards are changed each week on line-up day. They act as a check so that the right job is done first and no important part of the work is overlooked.

Fixtures for holding distributing and triple valves

By H. J. Duernberger

Air brake repairman, Michigan Central, Niles, Mich.

THE common practice when repairing distributing and triple valves, is to hold them in a bench vise. At best, this is an awkward method of holding the valves and considerable time is lost in changing them from one position to another to repair a particular part. In order to eliminate the time lost in making so many changes in the vise and also to make the job much easier, the writer developed a fixture for holding these valves which is used at all the principal repair points on the Michigan Central.

Fig. 1 shows a general assembly and detail view of the various parts of the fixture for holding the distributing valves. The base *J* of the fixture is bolted to the work bench with the removed portion flush with the front of the bench, and not over four feet from the regular bench vise so as to have it convenient for holding small parts from the valves. The stud at the center of the base passes through a hole in the bottom of the fixture. It then can be clamped in any position by the handle *P*. The distributing valve is bolted

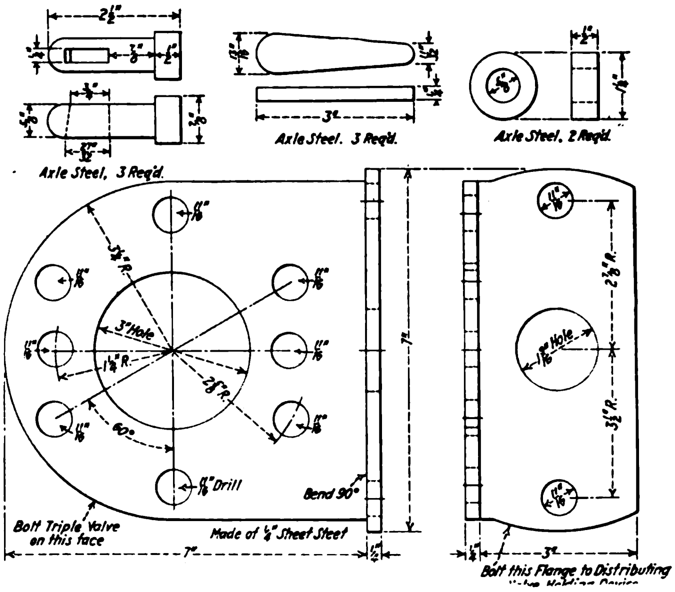


Fig. 2—Attachment used on the distributing valve device for holding quick action triple valves when making repairs

to the revolving head *B* in the fixture. It can be turned in any position by loosening the handle *I* and dropping it to the vertical position. The entire device can be turned to any

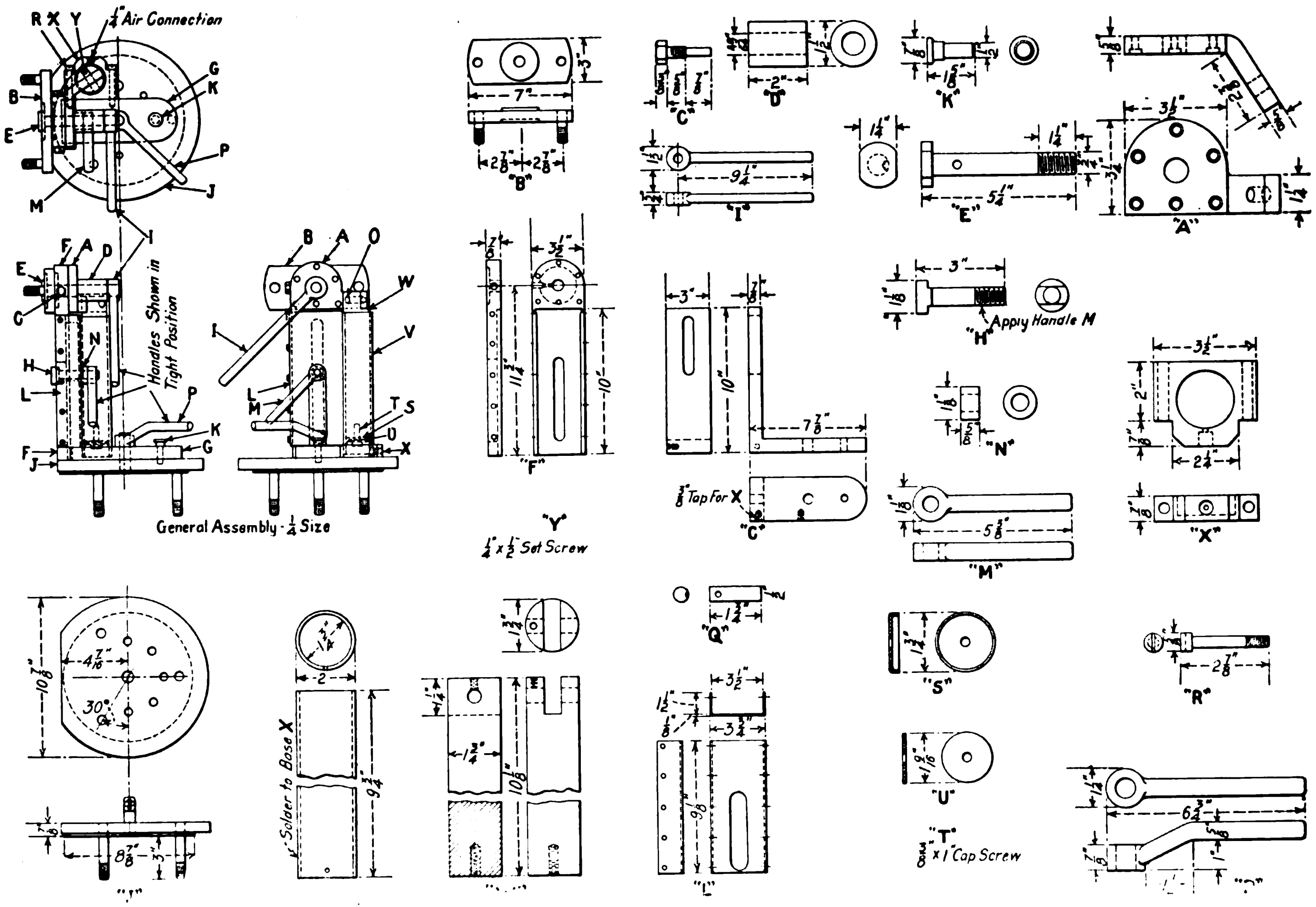


Fig. 1—Fixture for holding distributing valves in any position when making repairs

horizontal position by loosening the handle *P* and pulling out the pin *K*.

It is also provided with a raising feature which is very desirable when spotting in exhaust valve or equalizing slide valve seats. For all other work the lowered or normal position is the better. The fixture is raised by using compressed air. This is accomplished by using two 1/4-in. street ells at the point marked for an air connection. One ell should stand in a vertical position and the other be screwed into it so that it will face the rear of the work bench. Into this ell screw a 1/4-in. three-way cock. Then take a 1/4-in. drain cock and drill a 3/32-in. hole in one side of it and in the other side a 1/16-in. hole. By using a 1/16-in. side opening a more gradual lowering movement can be obtained than with a larger opening. The three-way cock is connected to the shop air line with a piece of welding hose which should have enough stock in it to allow for swinging the device. The full raised position is 7 1/2-in. higher than the normal which is desirable for the work mentioned.

Triple valve holding fixture

Fig. 2 shows an attachment for holding quick action triple valves while making repairs. It will hold valves with either two or three holes in the flange. It can also be used by a right or left handed workman. The one flange of the device bolts to the revolving head on the distributing valve jig. The two washers shown go on the two 5/8-in. studs on the revolving head plate and are held in place by two 5/8-in. nuts. The triple valve is then bolted to this plate with the bolts and wedges shown. These are used instead of threaded bolts as quicker results are obtained. This attachment, used on the distributing valve fixture, gives the latter the same advantage in repairing triple valves as when utilized for repairing distributing valves.

Replacing crank pins equipped with eccentric arms

How to eliminate the possibility of errors and reduce the cost of application

By R. B. Robinson

Machine shop foreman, Atlantic Coast Line, Hot Springs, Fla.

WHEN replacing main crank pins having eccentric arm connections, there are two general methods used:

First.—The crank pin is pressed into the driving wheel blank at the eccentric arm end and then, after the valves are set and the required position of the eccentric arm on the crank pin is found, the keyway is cut, the holes drilled and the eccentric arm is fastened to the crank pin.

Second.—The keyway is cut, the holes drilled in the crank pin and all work on the crank pin necessary to complete the fastening of the eccentric arm is done before pressing the pin into the driving wheel. Of this method there are two cases, *A* and *B*, referred to in accompanying illustrations.

Case *A* is the one generally used. This method will be compared with Case *B* to show the saving of time, the possibilities for the elimination of error, the simplification of method and the reduction of cost in the application of Case *B*.

Application of Case A

The first step of this method is that of scribing a line on the driving-wheel fit of the crank pin and continuing it to the eccentric arm fit at that end of the pin. This line is scribed before the crank pin is taken from the lathe and, when correctly scribed, is the line that would be made by the intersection of a plane through the centers of the crank pin, with the surfaces of the fits involved. It is this line which determines the position of the eccentric arm on the pin and the position of the crank pin. It also acts as a guide as the pin is being pressed into the driving wheel.

After this center line is scribed on the pin, the next step is to locate on the edge of the crank pin bore of the eccentric arm the point through which passes the line on the eccentric arm connecting the center of the eccentric pin with the center of the crank pin bore. This is the center line of the eccentric arm, and, when the arm is placed on the crank pin, is made to coincide with the scribed center line on the crank pin. The eccentric arm, after being fastened temporarily to the crank pin, has located on it the position of the keyway and its outline scribed on the crank pin. If the key way is the least bit out, the key must have an offset to make necessary corrections, for it is essential that the eccentric arm retain its position relative to the scribed longitudinal line on the crank pin, as this line is the one by which the crank pin is located in the driving wheel.

After the key is fitted and the eccentric arm is in the correct position on the crank pin, the pin is ready to be drilled for the eccentric arm bolts and then pressed into its place in the driving wheel.

After being slotted, drilled and otherwise prepared, the position of the crank pin in the driving wheel is determined by the longitudinal center line scribed on the crank pin intersecting at right angles another line scribed on the face of the driving wheel. This line is found by scribing a line through the center of the crank pin hole in the driving wheel and the point on the eccentric pin circle corresponding to the location which the center of the pin end of the eccentric arm is to have. This line is also made use of in the same manner in Case *B*.

The length of the eccentric arm and the diameter of the eccentric pin circle determine the location of the eccentric arm on the crank pin, and with this data, the position in which the finished crank pin is to be pressed into the driving wheel is found.

In the first method, that of fitting the eccentric arm to the crank pin after pressing the crank pin into the driving wheel, an error is not so likely to occur, but other complications arise. In small shops, not equipped for drilling and slotting outside of the machine shop, the situation becomes awkward. The cost of the work in preparing the

crank pin for the eccentric arm is much less if the work on the pin is all done in the machine shop before the pin is pressed into the driving wheel. While it becomes a simple matter to do all the necessary work on the crank pin before it is in place in the driving wheel every care in Case *A* must be taken in laying out the work.

Method of using Case B

In Case *B,* the laying out of the work becomes simplified and there is hardly any likelihood of an error. The length of time required to prepare the crank pin is less, as is the cost of the operation.

All that is required when using this method is to remove the turned pin from the lathe without any determining mark having been established on it (except, of course, the two center holes) and then to place the eccentric arm in position on the pin. Then run a scriber along the edge of the keyway in the eccentric arm, scribing its outline on the pin, remove the arm, cut the keyway in the pin, replace

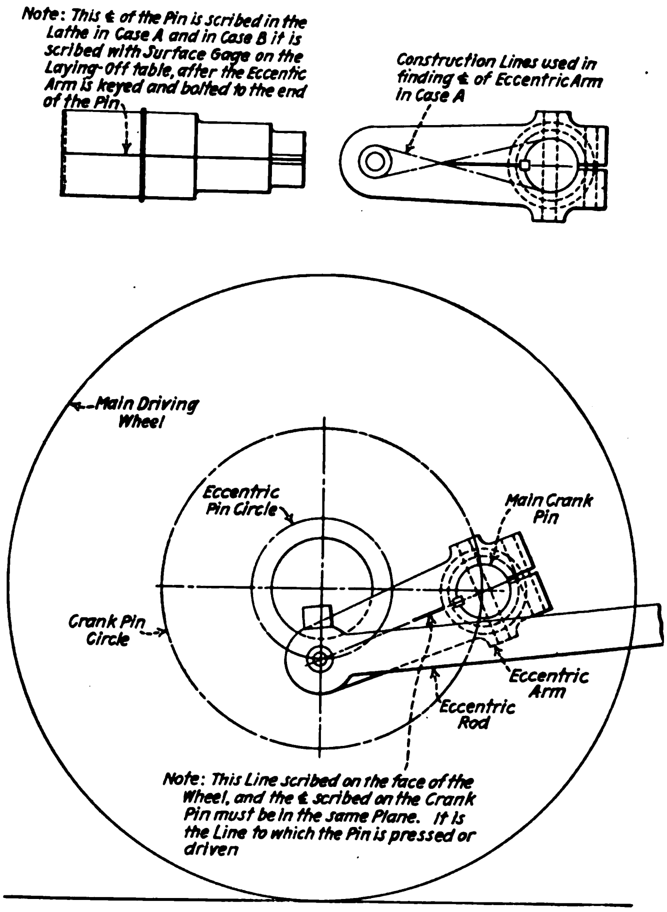


Diagram showing the method of scribing lines on crank pins and eccentric arms preparatory to replacing on the wheels

the arm on the pin and key it. After this, clamp the arm, drill the necessary holes, and fit the bolts in the pins. The next step is simply to place the assembled crank pin and eccentric arm on the laying-off table, and level it up so that the two centers of the crank pin and the center of the eccentric arm are all in the same plane parallel to the plane of the table surface. Then, with the surface gage set to the height of this plane, scribe one line along the driving wheel fit of the crank pin, allowing it to extend just over on the rod bearing fit so as to be visible for use in checking purposes after the pin is driven into place in the driving wheel.

The eccentric arm is then removed and the crank pin pressed into place, with its scribed line kept coincident with the end of the scribed line on the surface of the driving wheel, or, as already mentioned, in the same plane with it. Should the pin twist out of place before the act of pressing it in is completed it can be coaxed back into line with a chain and lever. This turning force is, of course, applied simultaneous with that of the pressing-in force.

The above description covers three ways of replacing a main crank pin when the valves are actuated from the movement of the crank pin by means of an eccentric arm fastened to it. The goal is to accomplish the installation of this pin in the simplest, most economical, and at the same time the most accurate, way.

The first method described is simple in plan but expensive in labor, time and power utilized. The second way, Case *A,* is economical as regards machine work, but requires the utmost care in laying out and, if the keyway on the crank pin and the subsequent drilling of the pin is not exact, troublesome and expensive allowances will have to be made. The third way, Case *B,* eliminates possible errors to a minimum and does not require the painstaking time of laying out the work that is required in Case *A.* The eccentric arm is simply keyed and bolted to the main crank pin in any radial position, then leveled up on the laying-off table and scribed. It is then ready to be pressed in the main driving wheel.

Eliminate guesswork in metal cleaning

THE days of guesswork are over. Industry of all kinds today is operated by accurate systems and rules that leave little room for deviation.

Present day business conditions demand that rigid economy be practiced, that the needless worker be dismissed, the needless machine junked, and needless expense stopped. This economy is perhaps of necessity even more rigid in the railway shop than in some industrial organizations.

Railway shops of every kind have cleaning of one sort or another to perform, such as the cleaning of air pumps, injectors, sheet metal, small parts, and the hundred and one materials that must be freed of their coating of oil or grease before inspection or before repair work can be undertaken. Modern cleaning materials have proved their superiority to commercial chemicals and ancient systems, but the economy to be gained from modern methods can only be greatest when a minimum of cleaning material is used. Modern metal cleaners, which may combine both chemical and mechanical action, cost more than lye or soda ash, but the quickness and thoroughness of their action outweigh the difference in price. In checking up the economy of each shop, some way must be devised to see that those actually putting metal cleaning material in the tanks do not waste it.

Proper amount of cleaner important

It has been proved that more time is lost in metal cleaning operations by the use of too much cleaner than by using too little. Aside from the time lost, the cost of the needlessly used cleaner soon totals a considerable sum. It is true that in many non-railway shops both of the above factors are far overbalanced by the use of improper and inefficient methods—no cleaning material is economical unless it is used in the way in which it was intended. The addition of air agitation, for instance, may materially reduce cleaning time and expense.

It would seem impossible that a cleaning tank operated under ordinary supervision could become so clogged with

cleaner that its effectiveness could become less than half normal. Such, however, is a frequent happening and until such conditions are eliminated, and until the practice of shoveling into the tank unrestricted amounts of cleaner is stopped, cleaning expense will be far above what it should be.

It does not take a trained chemist or mathematician to determine what amount of cleaner to add to a solution to maintain its efficiency. On the other hand, when a cleaner is costing six, eight, or ten cents a pound it is hardly wise to allow some unskilled laborer to shovel in more cleaner when things do not just suit him. Such methods frequently slow up cleaning instead of speeding it up.

The surest method of maintaining a metal cleaning solution at efficient and economical cleaning strength is by the normality test. The operation of this test is easily accomplished by any worker of average intelligence, and the apparatus required should cost but a few dollars. Unfortunately, the hydrometer test does not show the actual strength or alkalinity of a cleaning solution, inasmuch as it gives only specific gravity, which is affected in proportion to the amount of foreign matter in the solution. The hydrometer reading of a newly made cleaning solution is fairly accurate. Hydrometer readings are not, however, sufficiently accurate upon which to base computations for the recharging of a used solution.

Method of testing

After making up a solution of an alkali cleaning material, a simple method of determining the proper amounts of cleaner to add from time to time to maintain the original strength is as follows: When the solution is first made—for sake of illustration say three ounces to the gallon—obtain by means of a graduate marked according to the Metric system a 10 c.c. sample and allow it to cool. Then add a couple of drops of methyl orange solution (this may merely be labeled bottle No. 1), which turns the cleaning solution an orange color. Then, using a graduated burrette with a glass valve (and this is not nearly as technical as it sound in print) a solution of 10 per cent normal sulphuric acid is very slowly added until the cleaning solution in the beaker changes from orange to red. Sulphuric acid of this strength is readily obtainable and may merely be labeled bottle No. 2. A record must be kept of the number of graduations of acid required from the burrette to turn the sample of cleaning solution from orange to red.

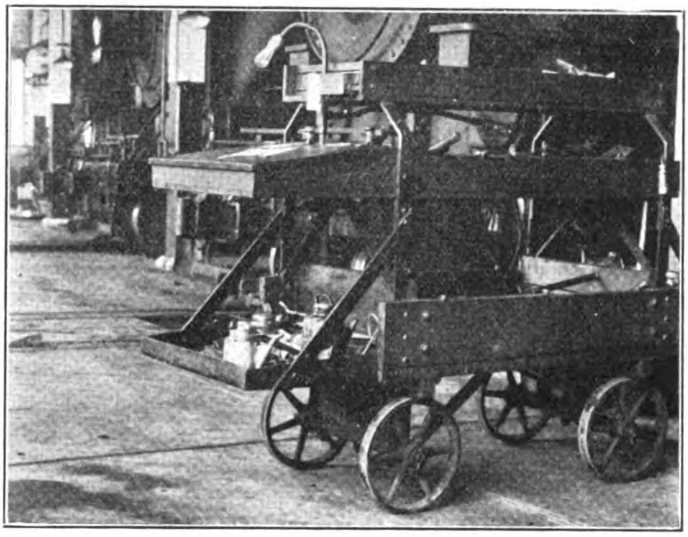
For example: If the initial test of the new solution required ten graduations of acid to turn the solution from orange to red, and if after using the solution and again testing as outlined above, it only takes nine graduations of acid to change the color of the solution, it shows that the cleaning solution has lost one-tenth of its original strength. It will therefore require but one-tenth of the original charge of cleaning material to bring the solution back to its original strength.

But how much chance is there of getting only the necessary amount of cleaner in the solution if someone is shoveling it in the tank by guess? And as the average person overguesses, the tank may soon be so supercharged with cleaner as to seriously retard the action; and then, of course, the particular cleaner being used is immediately pronounced unsatisfactory.

You do not guess in paying your men, or in paying for your various materials or supplies. Why guess at your cleaning operations? Why not know what amount of cleaner is needed to run a certain tank for a specified time or some certain operation, and then see that that amount is used, and no more.

Convenient wagon for the locomotive inspector

A WAGON which has been especially designed to meet the needs of the locomotive inspector is shown in the illustration. It is provided with three trays or boxes for tools, a shelf for oil containers and lubricants and a desk equipped with an electric light which can be plugged in at the nearest available wall socket. The lower tool tray has sufficient overhead clearance to permit it to be utilized for heavy tools and certain locomotive parts which can be quickly repaired or replaced by the locomotive inspector and his helper. The two top trays are convenient for the lighter hand tools such as hammers and wrenches, which are used more frequently. The desk has a lifting lid with compartments inside for the various forms and stationery necessary in making out work reports.



An inspector's wagon which may be moved to any place desired—Accommodations are provided for a desk, tools and necessary equipment

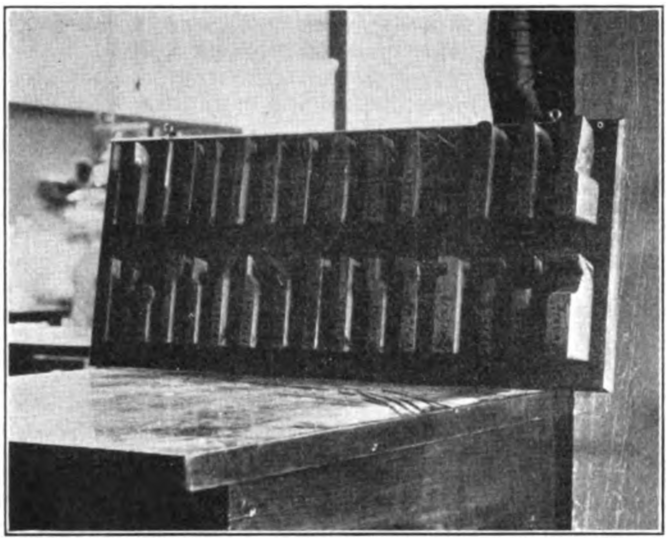
Wooden models for forging machine cutting tools

IT has been found from experience that the average blacksmith can forge out a better piece of work from an actual sample of the work than when he has to work from a drawing. One of the exacting jobs which a railway blacksmith has to do is the forging out of machine cutting tools preparatory for grinding.

It was found at the Billerica shops of the Boston & Maine that the blacksmiths were unable to satisfactorily forge these tools from blue prints. In order to overcome this trouble the drawings of 31 different types of lathe, planer, sharper and slotters tools were collected and taken to the pattern shop. The pattern maker carved to size, out of wood, exact duplicates of the actual tools and mounted them on a board. On the top edge of each tool it painted the dimensions of the steel from which the tool is to be forged. These tool models are also numbered from 1 up to 31.

This board is placed near the forge of the blacksmith who makes the tools. When a machinist needs a new tool he has his foreman make out a shop order on which is

written the number of the tool he wants made. This slip comes to the blacksmith who matches the number of the tool on the slip with the corresponding number on the

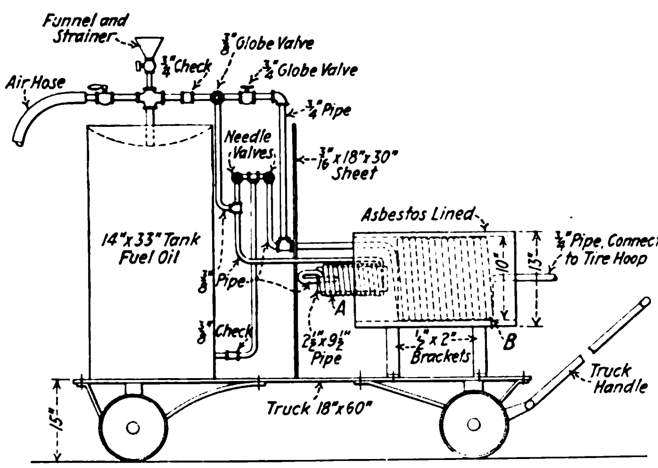


Models of 31 machine cutting tools to be used as guides by the blacksmith

board. This gives him a full size model to work from which has resulted in more accurate forgings. Thus less grinding by the machinist is required.

Fuel oil tire heater

Among the various labor saving devices described in the report of the convention of the General Foremen's Association, published in the October, 1924, number of the *Railway Mechanical Engineer*, was a portable fuel oil tire heater. This heater, which is shown in the sketch, has been adopted as standard on one of the western railroads. It may be used for removing and applying tires in engine-



Sketch of portable fuel oil heater

houses as well as in back shops. It is claimed to be an economical consumer of oil and simple to operate.

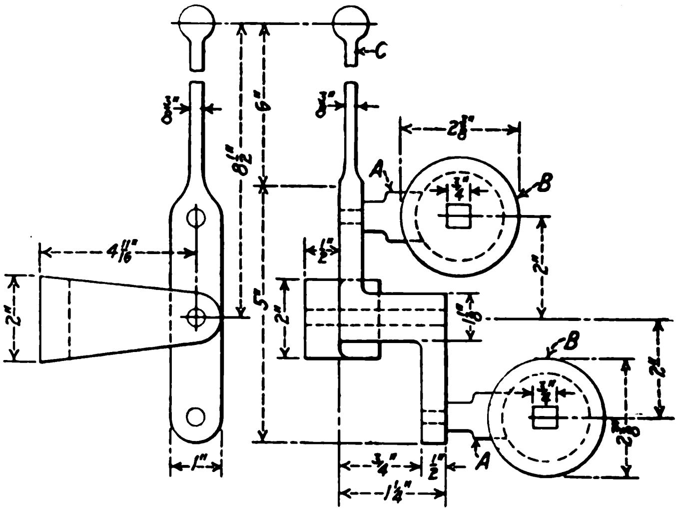
Referring to the sketch, the tank is filled with fuel oil through the funnel and strainer. Air pressure is supplied from the shop air line through the air hose shown at the extreme left. The air pressure forces the oil to the preheating torch *A*, which heats the main coil *B*. The circulation of the oil and air through the coil *B* causes the oil to be broken up into small particles and it is passed in this condition to the tire hoop. The rate of combustion is regulated by the globe and needle valves shown in the sketch.

This device can heat a tire for removal or application in 12 min. The heating process is so rapid that the wheel center does not absorb sufficient heat to interfere with the rapid expansion of the tire which makes it a most effective heater.

Feed gear shifting lever for Morton shaper

In order to facilitate the shifting of the feed gears on a Morton draw-cut shaper an operator employed in a large eastern railroad shop has devised the safety lever shown in the sketch.

A bracket and lever was bolted to the cross rail of the machine to eliminate the necessity of having to reach while sliding the feed gears into place. The gears *B*

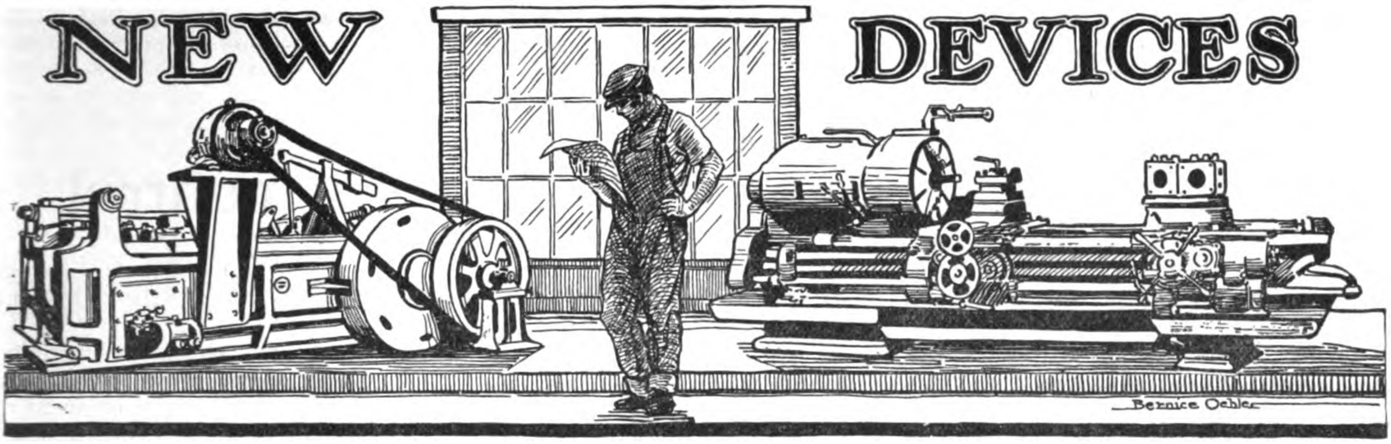


Safety lever designed to facilitate shifting the feed gears on a Morton draw-cut shaper

are grooved to receive the lugs *A* which are manipulated by the lever *C*.

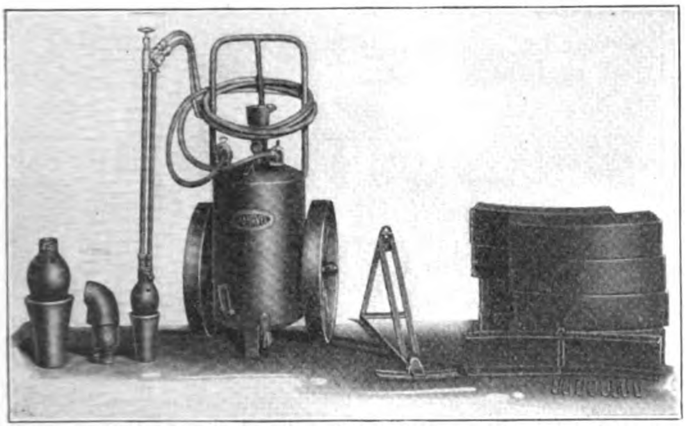
Only one gear is needed at a time to feed the table across the rail. The function of the other gear is to raise or lower the table. When one gear is in use the other gear is held in its proper position so that it will not accidentally slip into mesh.

Handling heavy castings without adequate crane service is expensive



Mahrvel vacuum torch and tire heater

THE Mahr Manufacturing Company, Minneapolis, Minn., has recently added a tire heating unit to its list of oil burning equipment. This equipment operates without pressure on the oil tanks or hose lines and therefore, removes the risk of fire or accident from bursting.

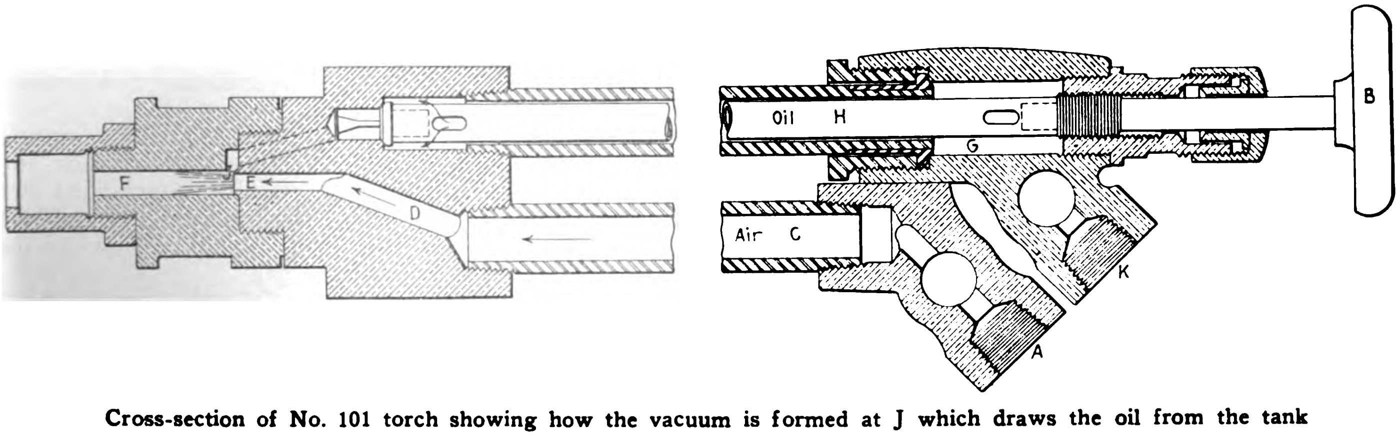


Vacuum torch and tire heater which operates without pressure on the oil tanks or hose lines

This feature can be understood by referring to the cross sectional view of the torch. A compressed air line carrying pressures ranging from 50 to 125 lb. per sq. in. is connected at *A*. The flow is regulated by the handwheel *B*, allowing it to pass through the drilled passages *C*, *D* and *E* and the air expands into passage *F*. This sudden expansion creates a vacuum at the points *J* in the corners of passage *F* which are untouched by the air as it leaves the passage *E*. The oil supply is led to the torch through a hose connected at *K*, enters the chamber *G* and is conducted to the valve seat through the seamless tube *H*. After passing the valve it is drawn into the air stream by the vacuum at *J*, where it is atomized and delivered from the torch end in a nozzle where combustion is started and completed with the addition of atmospheric air drawn in by the action of the jet.

It is essential that there be no leaks in the oil line between the point where the vacuum is created and the source of oil supply, as otherwise, air is admitted which breaks up the continuous column of oil and causes a sputtering flame, or if large enough, breaks the vacuum entirely and prevent any oil from being drawn up. A vacuum capable of lifting ordinary fuel oil 18 ft. is about the maximum for practical operation.

This type of torch is used in connection with the No. 101 Mahrvel safety vacuum tank. The unit consists of a light stand, special nozzle and steel housing. The housing is assembled by sections around the periphery of the tire to be removed and two flames, from the bottom of the tire and in opposite directions, are forced around its entire circumference within the housing. The major portion of the heat is confined in contact with the rim which increases the rapidity of heating.



Cross-section of No. 101 torch showing how the vacuum is formed at J which draws the oil from the tank

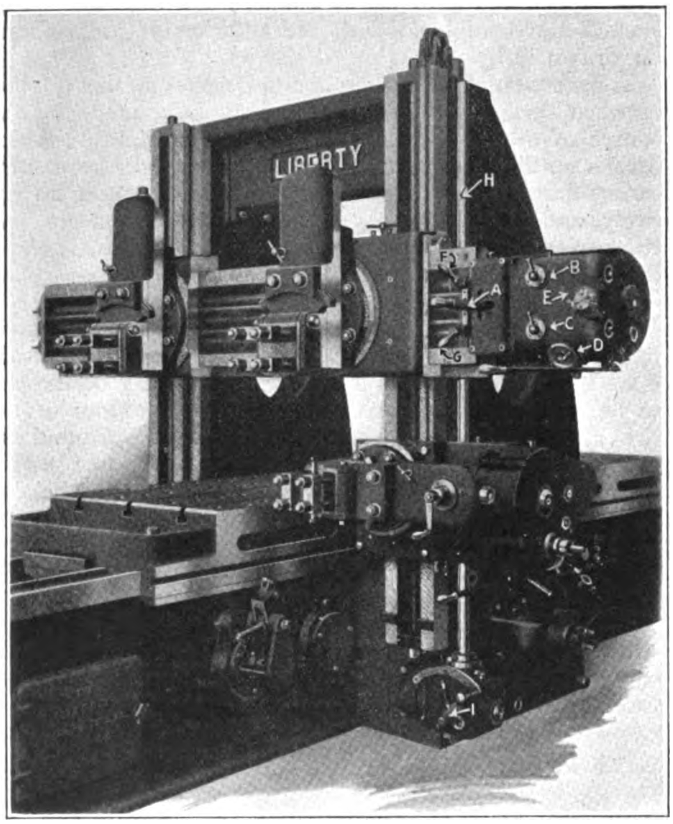
The combination of the torch and tire heater is especially convenient at terminal points where the torch has a variety of other uses. It can be used for thawing

out locomotive ashpans, etc. It can be used for firing up locomotives; for heating parts to be straightened and preheating parts to be welded; for thawing out frogs, switches, and other mechanisms around terminals. The compressed air may be supplied from the air pump on a locomotive.

Heavy-duty planer with compact control

A NUMBER of features in the planer recently designed and built by the Liberty Machine Tool Company, Hamilton, Ohio, are interesting departures from current practice. The cross rail is a self-contained unit, carrying all the mechanism necessary for power rapid traverse of the heads vertically and horizontally, as well as for elevating or lowering the cross rail. The unclamping, elevating, lowering and reclamping of the rail, as well as the power rapid traversing of heads vertically and horizontally are accomplished by the manipulation of lever *A*. To be able to accomplish these various movements with one lever eliminates the possibility of two movements at one time; making the control of the rail fool proof.

The levers *B* and *C* are the feed controls of the two heads vertically and horizontally, while by turning the hand wheel *D*, any desired amount of feed can be obtained as registered by indicator *E*. The 1½-hp. motor for power rapid-traversing and elevating the rail is built in and is located directly back of the rail. It receives

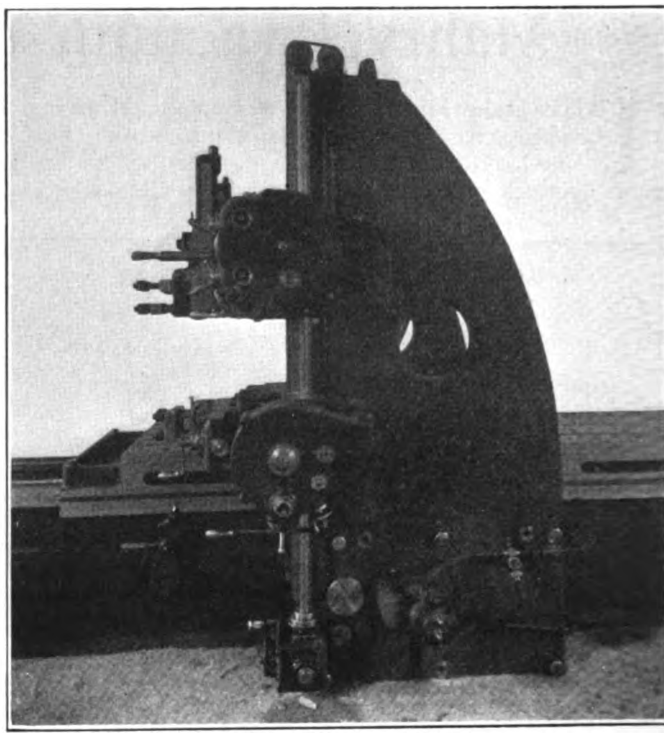


Liberty planer showing compact control mechanism

its current from protected trolleys and can be used on either alternating or direct current. If necessary, power may be obtained from a lamp socket. Both heads are moved on a single stationary screw which is in tension at all times. The nuts are revolved around the screw.

Lever *F* engages or disengages the horizontal feed of the left hand head or engages and disengages the vertical feed of the left hand tool slide, making it unnecessary for the operator to go to the opposite side of the machine for this adjustment, while the lever *G* controls the right hand head in a similar way.

Lever *A* controls an ingenious mechanism for clamping the rail to the housing, these clamps being located and operated on the inside of the housing. The movement of the tool slide vertically is accomplished by revolving a nut around a stationary screw which is stretched in tension.



Side view of Liberty planer showing motor for power rapid traversing head and elevating rail

The screws for elevating and lowering the cross rail serve a double purpose. These screws are also stationary and in tension, and so can be used for the purpose of feeding and power rapid traversing one or two side head thus eliminating two screws for operating a four-head planer.

The vertical shaft *H* is used only for transmitting power to the feed mechanism for both rail heads and side head, the transmission gears being so arranged that by moving lever *I* into one of two different positions, the feed may be made to take place either at the end of the cut, or just before entering the cut.

All gearing and mechanism on the end of the cross-rail for controlling the feed and power rapid-traverse, the gearing on the side head and also the feed mechanism at the bottom of the housing, run in oil. Gages indicate the oil level.

The housings extend entirely to the floor and are attached to the bed by means of reamed holes and bolts with additional heavy dowel pins for the purpose of eliminating any movement. The bed is of the double-wall type, ribbed lengthwise and crosswise and webbed

in on top. It is arranged for forced-feed lubrication to the Vs and is of double length, so the table at no time passes beyond the ends of the bed. Between the double walls of the bed are oil reservoirs for the horizontal shafts, the bearings of which are attached to the walls of the bed. Wick inserts extend the full length of the bed which convey oil, under pressure, to the bearings at all times. All oil entering these bearings must first be filtered through filtering stations in the bed, in addition, to passing through a ½-in. felt wick before entering the bearing. The machine is also equipped with a two-way pump located near the operator with a sight feed attachment so that he can make sure at all times that the oil is working properly.

The bed is also equipped with a tool cabinet for tools and clamps. A gear box is cast in the bed, in which heat-treated steel gears run continually in a bath of oil.

The table is of the box type construction provided with wide openings at the bottom of the T slots which allow the chips to fall through. This eliminates the necessity of clearing the chips from the slots before inserting clamping bolts. No mechanism appears on top of the machine, with the exception of the sheave wheels necessary to carry the counterweight for the side head.

Duplex spiral fluted staybolt tap

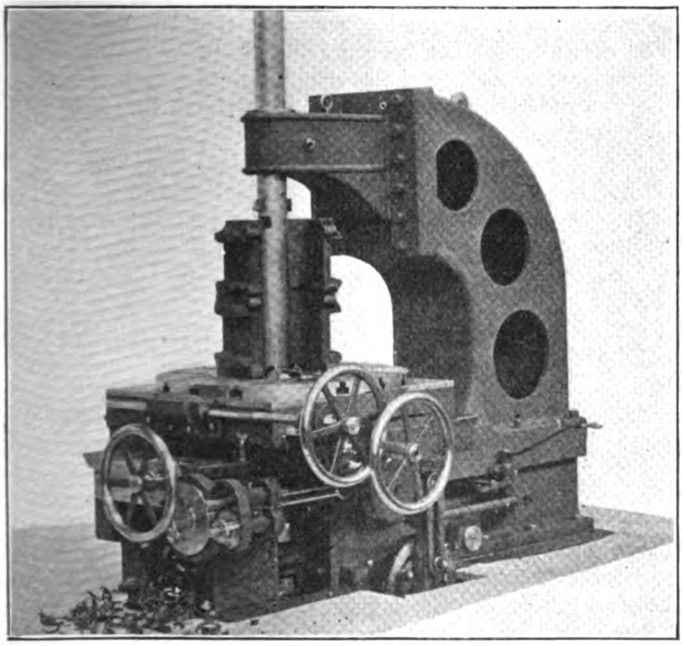
A STAYBOLT tap which consists of two spirals, opposite in direction, has recently been placed on the market by the W. L. Brubaker Brothers Company, Millersburg, Pa., under the trade name of Brubaker duplex spiral fluted staybolt tap.

Brubaker staybolt tap with the reamer portion made with a right-hand spiral

The tap is divided into five parts. Starting with the reamer end, they are the reamer, taper, thread and shank respectively. The reamer portion is made with a right hand spiral, thus giving it the action of a drill and reamer combined, while the tap is a left hand spiral, which gives it the same action as that of the regular Brubaker left hand spiral tap. It is claimed that the life of the tools are greatly increased by this design. They are manufactured by a special operation and are made of a steel carefully selected for this style of tool.

Draw stroke driving box slotting machine

A DRAW cut slotting machine primarily designed for machining locomotive driving boxes, but also adapted to a great variety of other slotting work in forgings or castings from which a large amount of metal is to be removed, or in long deep holes where the regular slotter cannot reach is a recent product of Baker Brothers, Inc., Toledo, Ohio. It will also do shaper work on the ends of long pieces of irregular shapes which are difficult to chuck on a planer. In addition it can be used for keyseating wheel centers up to 72-in. diameter.



Baker Brothers draw cut slotter set up for machining driving boxes

A 38½-in. diameter table with a 19¾-in. hole is placed low on the machine so as to be convenient for the operator. It is 32 in. above the floor level.

The bar carrying the cutting tool can be any size up to and including 4½ in. in diameter. The bar in the machine can be readily replaced by one of another size, by the substitution of suitable bushings. The support of the bar is very rigid. It is fixed at one end by clamping it in a long bearing in the driving ram, is supported by a bushing in the lower table directly below the work, and in a bushing in the upper arm directly above the work. The tool relief on the return stroke is secured by a clapper box in the cutter-bar. A 2-in. by 1-in. working tool can be used in the largest size cutter-bar.

Full automatic feeds are provided in all directions. All feeds are readily engaged by the operator when standing in front of the machine, all hand feeds being operated in the same manner. The length of the feed is adjusted at the right side of the machine.

The counterbalanced ram is driven by a rack and pinion through a heavy train of steel gearing. The reverse is accomplished by means of shifting belts which, for heavy duty, have been found very superior to any form of friction device. The shifting is actuated automatically which is an essential feature for smooth operation.

When so desired, the machine can be arranged for direct connected motor drive. A 20-hp. reversing planer type motor not to exceed 750 r.p.m. is recommended. The distance from the center of the cutter-bar to the box column is 35¼ in. The bar has a working stroke of 30 in. and an actual stroke of 33 in. The diameter of the table is 38½ in. The net weight of the machine is 18,000 lb.

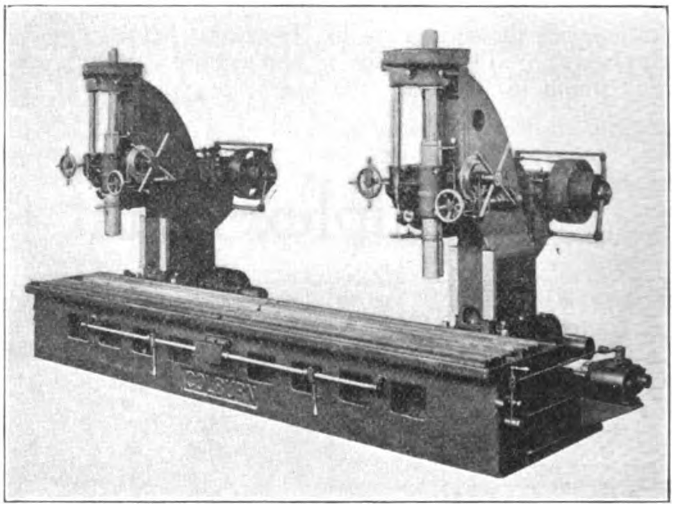
Adjustable spindle rod boring machine

THE advanced type of rod-boring machine shown in the illustration is a late product of the Colburn Works of the Consolidated Tool Corporation of America, Wilmington, Del. The machine is adapted not only to the boring of side rods, but on account of its great range, quick adjustment of heads to any desired position and the large number of speeds and feeds available, it can be used on a variety of work where holes are to be bored, drilled, faced, reamed or tapped simultaneously, or where one operation may be performed on the first spindle and another operation on the other spindle.

Each spindle is operated independently. If desired a tapping attachment may be applied to either head. Each spindle has an independent motor drive which travels with the head. These motors also furnish power for moving the heads longitudinally. The driving and feed gears run in oil. The driving shafts and the spindles are provided with ball bearings, and each spindle has a steady support and cutting compound pump. A cutting compound trough surrounds the bed.

The specifications of the machine are as follows:

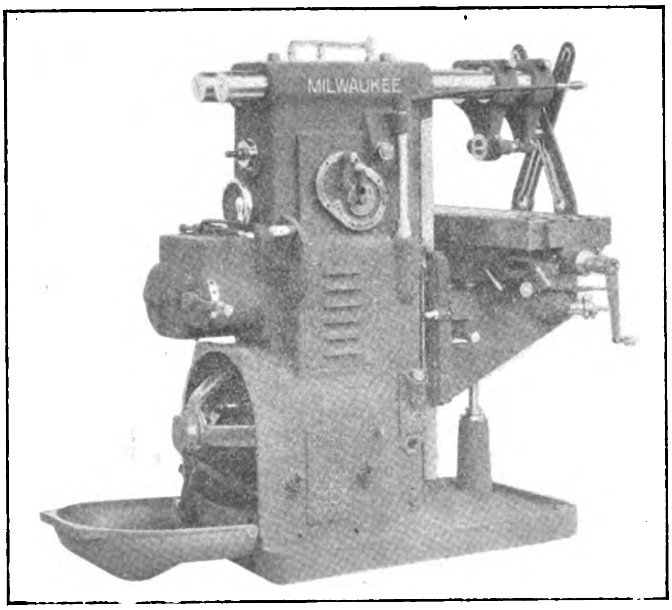
Drilling capacity in steel, 5 in.; swing, 36 in.; working surface of the table, 28 in. by 173 in.; vertical travel of the spindle 18 in.; maximum distance, the nose of the spindle to the table, 30 in.; eight speeds and six feeds for each spindle; taper in spindle, Morse No. 6; motors, two 15-hp., constant speed, to run at 1,200 r.p.m. The motors are not part of the regular equipment. The net weight of the machine is 35,000 lb.



Colburn two-spindle, locomotive rod-boring machine

Milling machine with the motor in the base

REALIZING that the modern tendency in machine design is to make each tool a simplified, compact unit, the Kearney & Trecher Corporation, Milwaukee, Wis., has added to its list of milling machines one which contains the motor drive in the base of the machine.



Milwaukee milling machine with the motor in the base

This feature utilizes the space in the lower part of the column and puts the motor out of the way, protecting it from dirt and dust. It also gives a quieter, more compact and economical installation, and follows the trend of the individual motor driven machine.

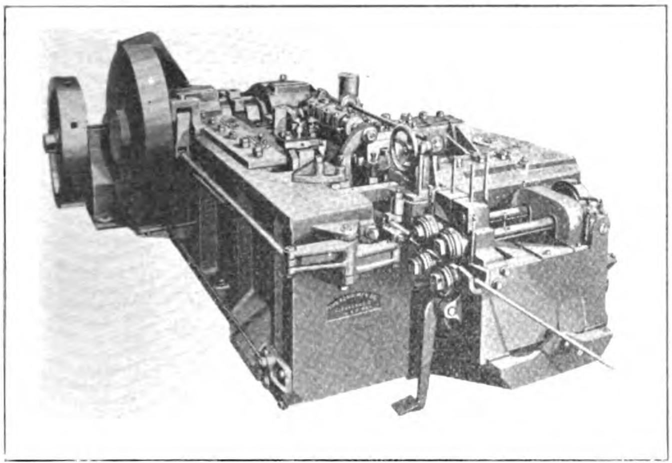
A direct geared drive, using no chain or belts is used. The driving pinion, mounted on the armature shaft, meshes directly with the driving gear leading up through the gear train in the column. The motor is placed with the driving pinion toward the front of the machine. In this position the brushes and commutator can be reached by removing the hinged cover at the rear of the column. The entire motor can be quickly slid out of its housing if any adjustments or repairs are required. Lubrication of the motor bearings are taken care of from the outside of the machine.

The drive is through a newly designed friction clutch, with the control lever extended and brought out to the front of the machine. This control lever may be adjusted to any angle desired for the convenience of the operator, or may be swung completely out of the way for very large work.

Another improvement consists of a new built-in power rapid traverse for the table. Table movements are readily controlled without any chance of confusion. A lever directly at the front of the table engages the table power feed in a direction determined by the lever movement. A second lever, conveniently located to the right hand of the operator as he stands in a normal operating position, may be shifted to change the table movement from the feed to the power rapid traverse rate. The levers are separated and the movements cannot be confused. Other levers controlling the engagement of cross and vertical feeds are located in convenient positions and completely separated from the table control levers. The other features common to the manufacturer's other millers remain unchanged, including an all-geared drive, automatic lubrication of column gearing, double overarm, etc. While this type of machine may be considered as particularly adapted to manufacturing rather than tool needs, it is built for toolroom accuracy and therefore can be used for this service.

Automatic bolt and rivet heading machine

A continuous motion bolt and rivet making machine which is designed for either hand or automatic feed and belt or motor drive has recently been developed by The Ajax Manufacturing Company, Cleveland, Ohio. The general arrangement has been improved by transferring the die-slide operating mechanism from the left to the right hand side, making it possible for the operator to feed the stock, watch the quality of the bolts or rivets as they come through the discharge port on the left, and adjust the stock gage all from one position. This arrangement leaves the left side of the machine clear, materially expediting the setting of the dies and tools.

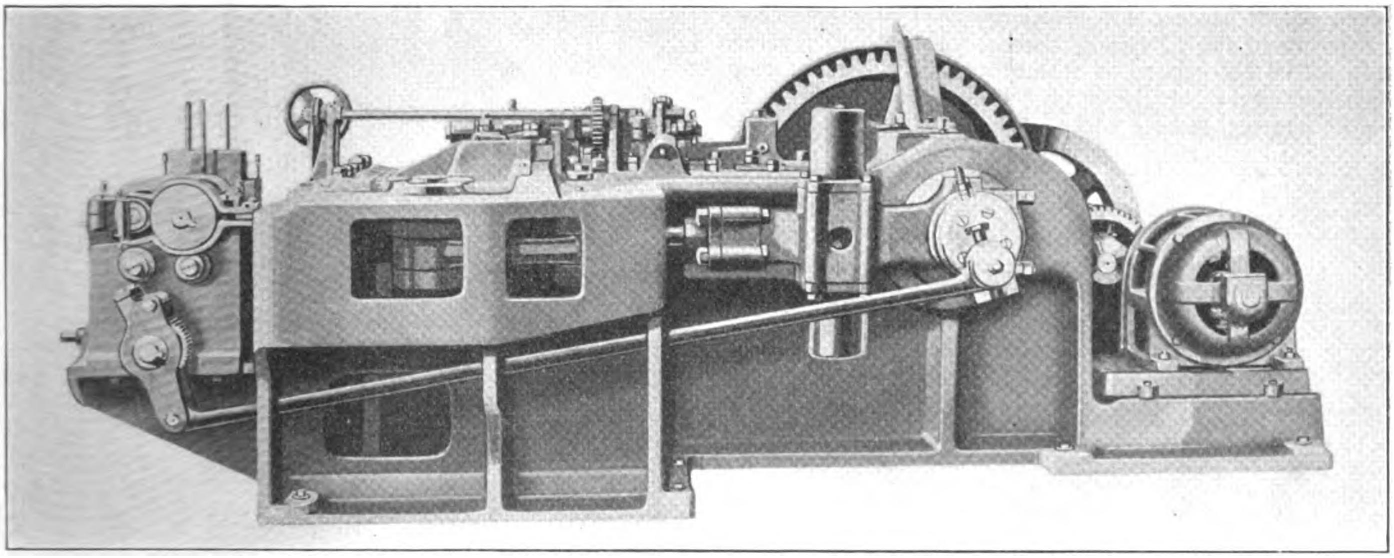


Automatic roll feed, motor driven, heavy duty, continuous motion heading machine

With the hand feed machine, rods heated to four or five feet in length are fed into the machine against the stock gage by the operator by hand, the machine shearing off a blank, heading and ejecting it. Outputs range from 14,000 to 18,000 counts every 10 hours. With the automatic roll feed, mill length rods are heated in a long furnace set about three feet from the front of the machine. The operator need only start the rod into the rolls, which feed it into the machine so that a piece is produced on each revolution. Outputs vary from 30,000 to 50,000 counts every 10 hours, depending on the length and size of rivets produced. The automatic roll feed mechanism is operated from an adjustable crank pin at the end of the crankshaft. The eccentricity of this pin is changed by means of an adjusting screw so that the rolls feed the correct amount of stock to produce any given length bolt or rivet.

The gears of this mechanism are completely enclosed in the feed housing. The ratchet arm is fitted with two dogs, staggered to give refinement of feed. The feed rolls which carry the heated bar stock consist of rings with the circumference grooved to suit the various sizes of stock. They are mounted in holders on the roll shafts so as to be easily changed for different sizes of stock and adjusted laterally for different shear center distances. The roll pressure is controlled by removable weights mounted on the bearings of the upper roll shafts which are movable vertically. In case of a sticker the feed can be stopped and locked out by depressing the foot pedal. An adjustment of distance between the feed rolls and the backing plate reduces waste from crop ends to a minimum. Finished pads on the front of the hand feed machines make it possible to attach this automatic roll feed mechanism at any time.

The belt driven machines are not geared, the flywheel being mounted directly on the end of the crankshaft. A clutch countershaft is provided as a standard accessory with all belt driven machines. Motor drive by direct gearing is provided for by extending the main bed casting to the rear to carry the pinion shaft and motor. A safety friction clutch coupling between this shaft and the main drive pinion cushions the motor from shocks and protects both the machine and the motor from damage should anything prevent a complete revolution of the crankshaft. The steel bed is of the ribbed type with continuous housings for the crankshaft bearings. It is extremely heavy and its deep sections and liberal flanges make it so rigid between crankshaft and backing plate, that it is not necessary to pack up excessively behind the



Automatic roll feed mechanism attached to the machine, showing the adjustable crank pin, the feed rod, the ratchet arm and the roll housing

heading tool to bring rivet or bolt heads down to the proper thickness. All wearing surfaces are suitably bushed and lined so that there is no direct wear of moving parts on the bed proper.

The header slide is top-suspended from V-type bearings. The trough ways of the bed, in which the header-slide bearings operate, are above the scale line. They are roll lubricated from two reservoirs and drain at the front, so that good lubrication with clean oil is maintained. The bearings on the header-slide and the ways in the bed are both removable for re-alinement. The die slide is top-suspended from plain bronze-faced bearings. A wedge liner on the crankshaft side, adjustable without removing any parts, makes it possible to keep the moving die back tight on the cutter, so as to shear the stock squarely. The self-adjusting side arm relief of the die slide actuating mechanism fully protects the machine in case a bolt or rivet lodges in or is caught between the faces of the dies. As soon as the obstruction is removed, the side arm automatically resets itself. The ejector is of the walking beam type operated from a cam on the inside of the flywheel. The cam is adjustable to control the time of kick-out and to offset any wear.

The stock gage can be adjusted by means of the hand wheel while the machine is running. The hand wheel is convenient to the operator as he watches the product being headed so that adjustments can be made quickly, for a slight variation in the stock diameter so that all heads will be properly filled out. The cam on the header-slide which actuates this gage is adjustable to change the timing for different shear center distances. Three types of gage arms are furnished for use when making short, medium and long rivets.

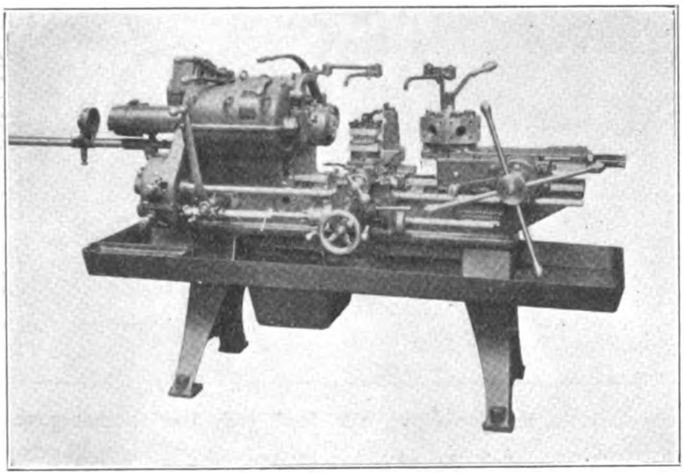
Both hand and automatic feed machines operate on the same principles so far as the heading mechanism is concerned. The heated bar is advanced through the breast plate until it strikes the stock gage which is so set that just enough of the bar projects through the breast plate to make a finished rivet. The moving die then travels across the breast plate shearing off the blank on the cutter, and gripping it against the stationary die. The header-slide moves forward, a cam on the top swings the stock gage out of the way and the heading tool in the toolholder heads the stock which projects from the dies, against the face of the dies. The heading tool then backs off and the dies open, whereupon the headed piece is kicked out of the dies by the ejector and drops out through the discharge port, completing the cycle. Water from overhead pipes is directed into the dies and the heading tool to keep them cool and carry away scale.

The power of the motor required is from 7½ to 20 hp. for machine sizes varying from ¾ in. to 1½ in. in the case of hand feed, and from 10 to 30 hp. for the same sizes in the case of automatic feed.

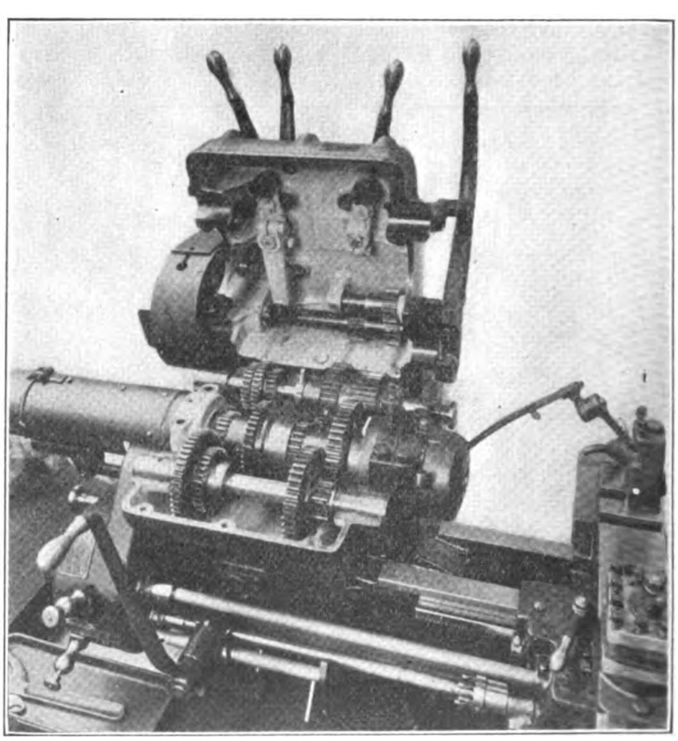
All geared head universal turret lathe

The Warner & Swasey Company, Cleveland, Ohio, has developed a universal turret lathe particularly adapted to small work. The distinctive features of this small machine are the tool carrying units with independent power feeds. The standard cross slide has five cutter positions, four on the square turret and one on the rear tool post. Cutters in their positions often operate simultaneously with the tools on the hexagon turret, which has six tool positions.

Any one of the 12 spindle speeds, forward and reverse, from 30 to 760 r.p.m., is instantly available by moving convenient levers on the head. This gives a wide selection of cutting speeds for all diameters and classes of work. The hardened gears run in oil and provision is made for easy adjustment of the frictions. The wide range of speeds and power of the all geared head enables this machine to pull stellite cutters to their capacity. It also makes possible the combining of a greater number of cutters to operate at the same time.



Warner & Swasey No. 4 universal turret lathe



Turret lathe with all geared head giving 12 spindle speeds

The machine is well suited to individual motor drive. The motor may be mounted at the rear of the machine or on the head-end leg, driving to the pulley by means of a belt. Where it is necesary to conserve floor space, the motor can be mounted on the head. The machine, when arranged for motor drive, may be placed where con-

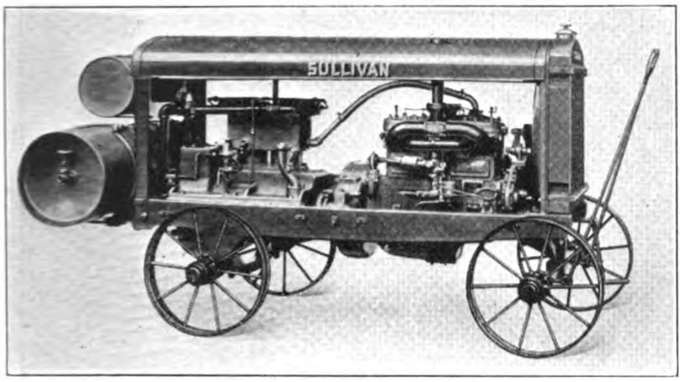
venient regardless of line shaft conditions. Waste space can often be utilized in this way, and if changes require moving, the machine may be quickly transferred.

Over seventy-five standard small tools are carried in stock for this machine. These tools greatly increase the productive possibilities of the turret lathe for all classes of work, and reduce the cost of tooling. The machine is claimed to be rapid in operation, easily handled and quickly tooled. It is, therefore, suitable not only for quantity production, but for use in the repair shop and the tool room where only a very few pieces are made at one time. The tooling is easily adjusted from one job to another and the twelve spindle speeds readily provide the right surface speeds for economical cutting.

The lathe is designed to be equally efficient for bar and chucking work. Round bars up to 1½ in. in diameter can be chucked through the automatic chuck. Ten inches is the maximum length which can be turned at any one setting of the turret saddle along the bed. For chucking work, a geared scroll chuck holds the piece. The maximum swing over the ways is 16 in. and over the carriage guides, 14¼ in.

Portable motor driven air compressor

THE rapid increase in the application of compressed air in railway practice, especially where the air cannot be readily piped, has called for the development of portable air compressors in a great variety of types and capacities. The machine shown in the illustration is a 103-cu. ft. gasoline engine driven, portable unit developed by the Sullivan Machinery Company, Chicago.



Sullivan portable, gasoline engine driven air compressor

The compressor is directly connected to a Buda, four cylinder, four cycle gasoline engine, and as stated, has a rating of 103 cu. ft. per min. against 100 lb. pressure, requiring 17 hp. for this duty. The compressor is a vertical, two cylinder, single acting, single stage unit, designed especially for this service. Lubrication is automatic and the cooling water for the engine and the compressor are supplied by a circulating pump in the same system. The air valves are the Sullivan "wafer" type, characterized by simplicity, strength, low clearance losses and quietness in action. The compressor, engine and equipment are mounted on a one-piece steel casting of rigid construction. The 12-gal. gasoline tank and the 18-in. by 48-in. air receiver are carried horizontally in cradles at the rear of the truck body, and all working parts of the compressor are protected, when not in use, by sheet steel sides which are locked in place against the base and the steel canopy top, thus protecting the outfit from the weather and from the theft of equipment.

This machine is mounted on a steel wheel truck and weighs 3,235 lb. in this form.

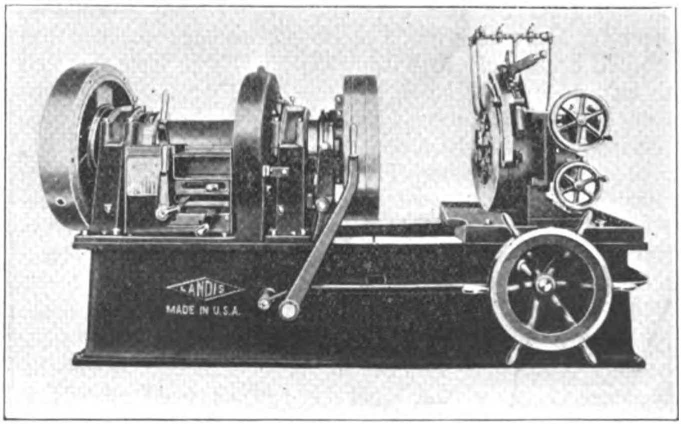
A six-inch pipe threading and cutting machine

A PIPE threading machine with a range from one inch to 6 in. has been added to its line by the Landis Machine Company, Waynesboro, Pa. Two die heads are employed for covering this range; one 2-in. head for a range from 1 in. to 2 in. inclusive, and a 6-in. head for a range from 2½ in. to 6 in. The entire range of each head is covered by one set of chasers. The travel of the carriage is 22 in. and has eight speeds. The speed of the 14-in. driving pulley is 300 r.p.m. The machine is 9 ft. 8 in. in length by 4 ft. 9¾ in. in width and weighs 8,800 lb.

The machine has a geared headstock and a single pulley drive. The variations in speed are obtained by means of a self-contained gear box, located beneath the main spindle. All the gears are cut steel and run in an oil bath. All bushings are bronze. The shaft bearings are lubricated automatically by a forced feed system. The main bearings are lubricated by flat link chains which run in oil contained in large reservoirs.

The front three-jaw chuck has a universal adjustment and is lever operated which permits the gripping and releasing of the pipe while the chuck is in motion. A universal geared, three-jaw chuck is employed at the rear of the machine and is fitted with flange grips for screwing flanges on and off. A reverse drive is obtained by a shifting lever for this operation.

The cross rail supports the die head, and is also fitted with cutting-off and reaming tools and a length gage. The die lubricating system includes a rotary pump, a by-



Operating side of the Landis 6-in. pipe threading and cutting machine

pass for the surplus oil and a special control valve at the head and cutting-off tools. All levers are located on the operating side of the machine in convenient reach for the operator.

This machine is very easily adapted to motor drive which can be applied after the machine is in service. The motor is mounted on a plate over the gear box and a silent chain transmits the power from the motor to the machine. A 7½-hp. constant speed motor, wound for an approximate speed of 1,200 r.p.m. is recommended which enables the machine to be operated at its maximum efficiency whenever desired.

The Landis stationary die head and long life tangential chaser is used on this machine.

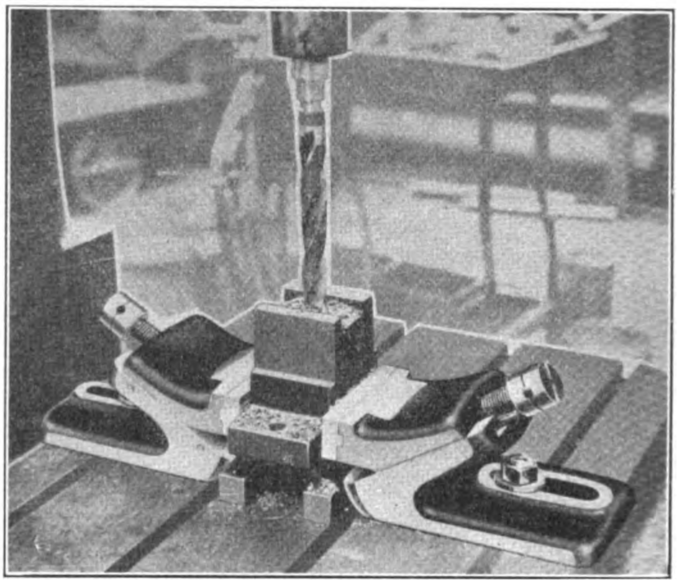
Coats divided machine vise

IT is not an uncommon sight in a railway shop to see a mechanic trying to set up on a machine an irregular shaped piece of work with all kinds of bolts, packing pieces, straps and wedges, because it is impossible to hold it in the machine vise. The Coats Machine Tool Company, New York, has developed a divided machine vise which apparently overcomes this difficulty. It is designed to hold parallel, tapered or irregular work. It combines adjustability in height with an unlimited span and beds the work truly on its supports, because of the compound parallel and downward movement of the jaws, eliminating the use of a hammer.

The body and jaws of the vise are made of close grain cast iron. The jaws are faced with hardened steel with serrated surfaces to insure a good grip. The screws are of steel and have right and left-hand threads, the left-hand thread running in a solid nut on the moving jaw, and the right-hand in the nut which is secured to the body. For each revolution of the screw, therefore, a movement of the jaws is obtained equal to twice the pitch of the screw, thus resulting in double action. The jaw is fitted to the body in V-guides, properly fitted, and an adjustable steel gib and screws furnish the necessary adjustment for wear.

They can be used either singly or in pairs, or three, four or more at a time may be employed for clamping irregular shapes. The jaws may be placed in any off-set position required by the shape of the work. Their main field of usefulness is on the tables of milling, drilling, shaping, slotting and planing machines which may be found in all railway shops.

The vises are made in three sizes, the width of the jaw ranging from 2½ in. to 10 in. and the diameter of the screw from ½ in. to 1½ in. The approximate weight per pair is 6 lb., 40 lb. and 220 lb., respectively, which takes care of all sizes of irregular work.

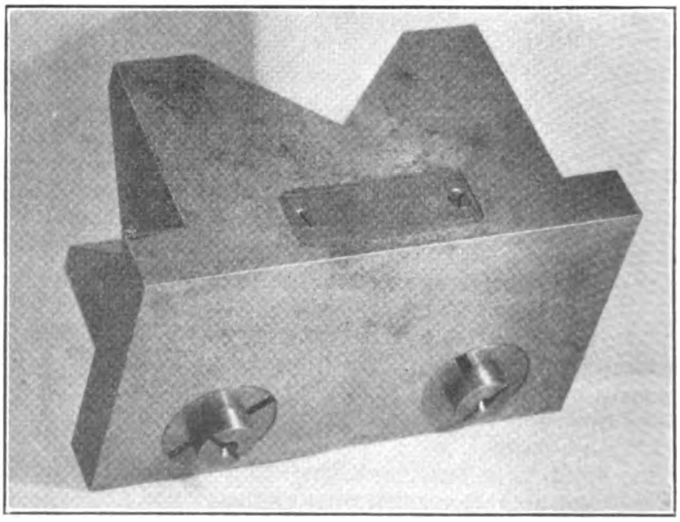


Divided machine vice for holding any irregular piece of work

Crescent V-type work support

THE use of V-blocks has always proved a time-saving device on lay-off tables and on all types of machines. A useful type of V-block has recently been designed by the Crescent Engineering Company, Baltimore, Md. It is made of close grained, grey iron and machined accurately to within .001 in. The base is fitted with two ⅝-in. tool steel, hardened and ground pins, operating in steel bushings. They can be locked up or down as desired, and can be changed in a few seconds with the use of a screw driver. The pins on the support shown in the illustration are off center which is very desirable as it enables the operator to use the block partly overhanging a machine edge, and still have sufficient base for clamping solidly.

With the pins extended, the tool can be used in connection with the service slots of any machine for quick alinement with the spindle or table travel. With the pins screwed up in the block, it can be used anywhere as a regular V-block. It has suitable clamping flanges and is made in three sizes.



V-type work support provided with clamping flanges

General News

The suggestion plan placed in effect by the Missouri Pacific last August, under which its employees are encouraged to submit plans for bettering shop practices, has been accorded the enthusiastic support of employees throughout the system. Under the plan the employees elect production and executive committees to pass upon the suggestions submitted. At Sedalia, Mo., where the suggestion plan first went into effect, approximately 90 per cent of all those employed at the Sedalia shops indicated their interest by casting ballots for members of the committees.

Howell-Barkley bill again passed by

A fourth day on which the Howell-Barkley railroad labor bill might have been considered in the House of Representatives was allowed to pass by on January 19 without any effort being made by the advocates of the bill to have it taken up. The bill is on a House calendar that comes up only every other Monday but so far at this session of Congress no effort has been made to have the bill considered. The Senate committee, having reported the bill with an amendment, is giving it no further attention, although some of the advocates of the bill say they are still hoping to have the amendment put in a more desirable form.

General Atterbury becomes mechanical division representative on A. R. A. board

According to the articles of organization of the American Railway Association, a member of the board of directors is to be selected by the board to represent it in the work of each division and, in effect, to represent the division on the board of directors of the parent association. The members of the board so selected form the Executive Committee.

At a meeting of the board of directors held on January 6, Gen. W. W. Atterbury, vice-president of the Pennsylvania System, was elected to succeed W. B. Storey, president of the Atchison, Topeka & Santa Fe, as Mechanical Division representative. Mr. Storey has served in this capacity since the establishment of the present form of organization of the A. R. A.

Mr. Atterbury is succeeded as the representative of the work of Division 1—Operating, by Carl R. Gray, president of the Union Pacific System, the newly elected member of the Executive Committee. H. E. Byram, president of the Chicago, Milwaukee & St. Paul, is also a newly elected member of the Executive Committee, representing Division VII—Freight Claims, which, until his selection, had been without Executive Committee representation. The complete list of division representatives is as follows:

Division I........... Operating, C. R. Gray, president Union Pacific System.
Division II.......... Transportation, E. J. Pearson, president, New York, New Haven & Hartford.
Division III......... Traffic, C. H. Markham, president, Illinois Central.
Division IV.......... Engineering, J. Kruttschnitt, chairman, Southern Pacific.
Division V........... Mechanical, Gen. W. W. Atterbury, vice-president, Pennsylvania System.
Division VI.......... Purchases and Stores, W. G. Besler, president, Central of New Jersey.
Division VII......... Freight Claims, H. E. Byram, president, Chicago, Milwaukee & St. Paul.

Wage statistics for October

In the month of October, 1924, the employment on Class I railroads reached the highest point since November, 1923, according to the Interstate Commerce Commission's monthly bulletin of wage statistics. The total number of employees reported was 1,822,616, an increase of 21,320 or 1.2 per cent over the number reported for September, 1924. The total compensation increased $14,825,589 or 6.2 per cent. The ratio of increase in the compensation is greater than the ratio of increase in employment because of the fact that October had 27 working days while September had only 25.

Compared with the corresponding month last year, the employment in October, 1924, decreased 5.9 per cent and the total compensation shows a decrease of 5.7 per cent.

Labor news

SHOP EMPLOYEES of the Delaware, Lackawanna & Western have finally called off the strike which has been effective since July 1, 1922. The Lackawanna has issued a statement that the men will not be given their old jobs back but will have to apply for work as new men.

THE GULF, COLORADO & SANTA FE has negotiated an agreement with the engine service employees similar to that made by the Southern Pacific which grants wage increase of approximately six per cent and changes a few minor working rules. The Atchison, Topeka & Santa Fe, Eastern, Western and Coast Lines, are now meeting the representatives of Brotherhood of Locomotive Engineers and Brotherhood of Locomotive Firemen and Enginemen to reach agreements affecting the employees of those lines. The Terminal Railroad Association of St. Louis has also signed an agreement with engine service brotherhood on the Southern Pacific basis, calling for the wage increase without changes of working rules.

LABOR BOARD REPORTS ON DECISIONS RENDERED.—In a report furnished to the congressional appropriations committee, the railroad labor board announced that it had rendered 706 decisions during 1924, of which 333 favored the railways; 323 favored the employees and 50 either decided nothing or decided partly for the managements and partly for the employees. Most of the organizations, with the exception of the four train and engine service brotherhoods, were given a majority of the favorable decisions on disputes in which they took part.

WESTERN PACIFIC WAGE INCREASE FOR ENGINEMEN.—The Western Pacific has made an agreement on wage increases with its engine service employees, represented by the Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen and Enginemen, similar to that made by the Southern Pacific with its enginemen. The agreement awarded a wage increase of approximately six per cent to the men without changes of working rules. Like the Southern Pacific, the Western Pacific was one of the roads which were parties to the recent dispute before the Railroad Labor Board, in which the board approved the wage advance only on condition that certain burdensome working rules be amended.

C. & S. UPHOLDS DECISION IN ENGINEMEN'S WAGES.—Demands of the Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen & Enginemen, that the engine service employees of the Colorado & Southern receive a six per cent wage increase without changes in working rules, have been flatly refused by W. P. Hayden, assistant general manager of the Colorado & Southern. He declared that the Colorado & Southern would stand squarely behind the decision of the United States Railroad Labor Board which granted the wage increase only on condition that the brotherhoods accept changes in some of the more burdensome rules. Although negotiations are continuing and no strike vote has been taken, the brotherhoods are expected to take the same action on the Colorado & Southern as they took on the Southern Pacific to enforce compliance with their demands. On the Southern Pacific an overwhelming majority of the employees are said to have voted to strike if the agreement they had proposed was not approved by the management.

AN AGREEMENT CALLING for a wage increase of approximately six per cent without changes in important working rules, similar to that made on the Southern Pacific, has been approved by the Chicago & North Western and its engine service employees represented by the Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen and Enginemen. Although the North Western was one of the roads involved in the recent Labor Board decision which granted the wage increase to the

enginemen only on condition that they accept a number of changes in important working rules, it followed the example of the Southern Pacific and the Western Pacific in not insisting that this decision be made the basis of an agreement. The policy of the brotherhoods has been to ignore the board's decision and to force agreement to their demands of wage increases without changes in working rules through negotiations with individual managements in which strike threats are freely made. So far as is known, no railway has succeeded in making an agreement with its engine service employees on the basis of the Labor Board's decision, although one road, the Colorado & Southern, is known to have insisted that it will make no agreement on any other terms.

Power of labor board again upheld.—The right of the United States Railroad Labor Board to compel witnesses to appear and testify before it, was upheld for the second time by Federal Judge Wilkerson of the United States District Court at Chicago on January 12. The suit was brought by the Labor Board against J. Maguire, chairman on the Chicago & North Western of the Brotherhood of Locomotive Engineers, who refused to testify in the board's hearing of the dispute between the western railways and their engine service employees. In spite of the fact that the representatives of the employees did not testify at the board's hearing, a decision on the dispute was rendered sometime ago, awarding a wage increase of six per cent to the employees on condition that they accept a number of changes in working rules.

The Labor Board had previously won a similar decision in the United States court in the case of D. B. Robertson, president of the Brotherhood of Locomotive Firemen and Enginemen. As was done following the court's ruling on the Robertson case, counsel for Mr. Maguire will appeal Judge Wilkerson's decision. The Robertson case is now pending in the United States Supreme Court.

The brotherhoods took the position that the Labor Board's orders had been held unenforceable by the United States Supreme Court and that it was a mere arbitrary body without power to compel testimony. They also charged that Ben W. Hooper, chairman of the board, was prejudiced against them.

"The Labor Board does not act as an arbitrator in the proper sense of the word but as an administrative body," said Judge Wilkerson in considering these contentions. "Its acts, if arbitrary, are void. Whether its acts are arbitrary is to be determined, not by the state of mind of one of the members, but by the acts themselves." Judge Wilkerson declared that in his opinion the proposed compulsion of testimony does not violate the fifth amendment of the constitution and that the interest of a witness in a dispute does not preclude the board's making him testify in connection with it.

Meetings and Conventions

General Foremen's Association

The International Railway General Foremen's Association has appointed committees to report on the following topics at the annual convention in Chicago next September.

Automatic train control—Charles C. Kirkhuff, Atchison, Topeka & Santa Fe, Chicago, chairman.

Supervision and repairs of special appliances, boosters, reverse gears, feedwater heaters, etc.—J. H. Armstrong, Atchison, Topeka & Santa Fe, Topeka, Kans., chairman.

Straight line or spot system of car repairs—G. P. Hoffman, Baltimore & Ohio, Baltimore, Md., chairman.

What can the general foreman contribute to obtain more ton-miles per shop man-hour?—F. B. Harmon, Atchison, Topeka & Santa Fe, San Bernardino, Cal., chairman.

Reclamation of material, car and locomotive—A. J. Larrick, Baltimore & Ohio, Chillicothe, Ohio, chairman.

Best routing system to increase shop output—Wallace Murray, Chicago, Rock Island & Pacific, Silvis, Ill., chairman.

Additional information may be obtained from the secretary-treasurer of the association, William Hall, Winona, Minn.

An appreciation of Secretary Kline

The January meeting of the Car Foremen's Association of Chicago was held at the Great Northern hotel on Monday evening, January 12. The first part of the meeting was devoted to a discussion of the new A. R. A. rules under the direction of the association's committee on that subject. The latter part of the meeting was given over to a celebration of the twenty-fifth anniversary of the election of Aaron Kline as secretary of the association. Mr. Kline was given a rising vote of thanks for his faithfulness and effective work in increasing the association's membership and influence among railroad car foremen, car inspectors and other car department employees. Instead of making Mr. Kline some gift in token of his long and faithful service, the board of directors voted to grant him an increase of salary as a more effective way of showing their appreciation. Photographs of past presidents were posted around the walls of the meeting room and Mr. Kline received personal letters of appreciation from all living past presidents.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next meeting May 5-8, Los Angeles, Cal.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin ave., Chicago.

American Railway Association, Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

Division V.—Equipment Painting Section.—V. R. Hawthorne, Chicago. Business meeting to be held in Chicago during week commencing June 15. No exhibit of railway supplies and machinery will be held.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet Ave., Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division. A. F. Steubing, Bradford Corp., 25 West Forty-third street, New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Canadian Railway Club.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting February 10. Paper will be read on Foundation Brakes, by W. H. Clegg, chief inspector, air brakes and car heating equipment, Canadian National, Montreal.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Next interim meeting February 12. Paper on "Locomotive Feed Water Heating," will be presented by L. G. Plant, assistant to the president, National Boiler Washing Company, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November. Next meeting February 10. Paper on "Three Cylinder Locomotives" will be read by Perry T. Egbert, representative, American Locomotive Company. Illustrated by moving pictures.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland. Next meeting February 2. Discussion of A. R. A. Rules.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention, Hotel Winton, Cleveland, Ohio, August 18, 19 and 20.

International Railway Fuel Association.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill. Next annual convention May 26-29, Hotel Sherman, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash St., Winona, Minn.

Master Boiler Makers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Next convention May 19-25, Hotel Sherman, Chicago.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting February 10. Methods of Analyzing Shop Output and Costs will be discussed by J. E. Slater, special assistant to general manager, New York, New Haven & Hartford.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

Railway Club of Greenville.—F. D Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Next meeting February 13. Moving picture entitled, "Oxygen, the Wonder Worker," produced by the United States Bureau of Mines in connection with the Air Reduction Company, will be shown. Oxy-acetylene application will also be demonstrated.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

Traveling Engineer's Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September, 1925, Chicago.

Western Railway Club.—Bruce V. Crandall, 189 West Madison St., Chicago. Meetings third Monday in each month, except June, July and August. Annual meeting May 23, Edgewater Beach Hotel, Chicago.

Supply Trade Notes

Henry W. Jacobs, formerly president of the Oxweld Railroad Service Company, Chicago, died on January 6 in Chicago.

The United Alloy Steel Corporation plans the construction of two one-story brick and steel factory buildings at Canton, Ohio.

William S. Estell, who retired as secretary of the Adams & Westlake Company, Chicago, in 1923, died on January 4 in Chicago, of pneumonia.

John Heller, for a long time one of the directors of the International Oxygen Company, Newark, N. J., has been appointed sales manager.

The McMyler-Interstate Company, Cleveland, Ohio, has removed its Detroit office from 1701 Washington Boulevard building to 1156 Book building.

Glenn G. Howe, for many years senior vice-president of the Link-Belt Company, Chicago, died at his home in Muskegon, Mich., on December 25.

The DeVilbiss Manufacturing Company, Toledo, Ohio, has opened an office and display room at 1006 Republic building, State and Adams streets, Chicago.

The Truscon Steel Company, Youngstown, Ohio, is contemplating the erection of a one-story factory branch and district plant at Jacksonville, Fla., to cost approximately $25,000.

O. D. Hays, district manager of the Oxweld Railroad Service Company, with headquarters at Atlanta, Ga., has been transferred to the Southwestern district, with headquarters at St. Louis, Mo.

Daniel O'Rourke, superintendent at the east portal of the Moffet tunnel, has been appointed special representative of hammer drills of the Sullivan Machinery Company, with headquarters in Chicago.

E. J. Costello, Jr., representative of the Truscon Steel Company, with headquarters at Pittsburgh, Pa., has been appointed sales engineer in the railroad department, with headquarters in New York.

The St. Louis Forgings Company, a subsidiary of the Standard Forgings Company, Chicago, has purchased the forging plant of the Laclede Steel Company, East St. Louis, Ill., and plans to expand the new plant.

O. L. Chapman has joined the sales organization of the Scott Valve Manufacturing Company, Detroit, Mich. Mr. Chapman will devote his time to the application of valves to manufacturing plans and similar lines of industry.

The business heretofore conducted under the name of the Franklin Railway Supply Company of Canada, Ltd., Montreal, Quebec, will be continued under the same management in the name of the Franklin Railway Supply Company, Ltd.

William P. Kirk, district manager of sales of the Niles-Bement-Pond Company, with headquarters at Cincinnati, Ohio, has been transferred to New York and will be succeeded by E. H. Gates, manager of Rochester, N. Y., branch office.

The Wanner Malleable Castings Company has been organized under the laws of Delaware with a capitalization of $1,850,000 and will take over and expand the plant and business of the Wanner Malleable Castings Company at Hammond, Ind.

Joseph W. Irwin, until recently president of the Mitchell Spring & Manufacturing Company, Johnstown, Pa., has resigned to become connected with his former associates as general superintendent of the Fort Pitt Spring & Manufacturing Company, Pittsburgh, Pa.

D. Maxwell, district manager of the Williams Tool Corporation, with headquarters at Chicago, has been transferred to Cleveland, Ohio, and will be succeeded by William J. Eberlien, store manager of the Greenfield Tap & Die Corporation, with headquarters at Chicago.

Henry W. Darling, for more than 30 years treasurer of the General Electric Company, Schenectady, N. Y., has resigned, and has been succeeded by R. S. Murray, who had been assistant treasurer of the company since 1910. In accepting the resignation of Mr. Darling as treasurer, the board of directors elected him a vice-president, with such duties as shall be assigned to him by the president.

A. E. Huckins, vice-president of the Burr Company, engineers, founders and machinists, specializing in the manufacture of dynamometer apparatus for railways, with headquarters at Champaign, Ill., has resigned. This company has also discontinued its Chicago office.

William H. Utz, vice-president and formerly European director of Jenkins Bros., Limited, with headquarters at London, England, has been appointed director of sales of Jenkins Bros., valve manufacturers, New York. Mr. Utz will have general charge of the selling activities of the company.

E. P. Essley, secretary of the E. L. Essley Machinery Company, Chicago, has taken over the duties of sales manager, formerly carried on by James J. Shanahan, general manager, resigned. Other departments of the general manager will be under the direct supervision of E. L. Essley, president.

C. T. Knissely, president of the Knissely Brothers Manufacturing Company, manufacturers of hollow metal fireproof doors and window sills, has been appointed sales manager of the Railway Brakeshoe & Foundry Company, with headquarters in the newly opened office, 5 South Wabash avenue, Chicago.

Col. Eugene C. Peck, who has served for almost 25 years as general superintendent and later as works manager of the Cleveland Twist Drill Company, Cleveland, Ohio, has retired from active management. He will continue, however, as a stockholder in the company and as a member of the board of directors.

The Brown & Sharpe Manufacturing Company, Providence, R. I., at a recent meeting of the stockholders, elected the following officers: William A. Viall, Henry Buker and Paul C. DeWolf, vice-presidents; John A. Cave, secretary; John Sharpe Chafee and Richmond Viall, assistant secretaries. Henry D. Sharpe continues to hold the office of president and treasurer.

Lawrence Richardson, sales engineer of the Whiting Corporation, Harvey, Ill., and Col. C. H. Crawford, general representative of the Baldwin Locomotive Works in Brazil, with headquarters at Rio de Janeiro, have joined the Dwight P. Robinson Company, Inc., New York. Mr. Richardson will be located in New York for about a month until definite plans are formed.

Ambrose N. Diehl, general superintendent of the Duquesne Works of the Carnegie Steel Company, has been elected a vice-president in charge of operations in the Pittsburgh district, with headquarters at Pittsburgh, Pa. J. Lamont Hughes, general superintendent at Youngstown, Ohio, has been elected a vice-president in the Youngstown, Ohio River and Valley district; Samuel G. Worton, assistant superintendent, succeeds Mr. Diehl, and David C. Burroughs, superintendent of the electrical department, has been appointed assistant general superintendent at the Duquesne Works.

The Associated Machine Tool Dealers has been organized by manufacturers and dealers in machine tools to promote a closer relationship and co-operation between manufacturers and dealers. Officers of the new organization are: president, G. E. Merryweather, of the Motch & Merryweather Machine Company, Cleveland, Ohio; vice-president, Marshall Prentiss, of Henry Prentiss & Company, New York; secretary, T. W. Carlisle, of the Strong, Carlisle & Hammond Company, Cleveland; and treasurer, G. H. Cherrington of the Brown & Zortman Machinery Company, Pittsburgh, Pa.

Francis C. Pratt, vice-president in charge of engineering of the General Electric Company, has been appointed to fill the vacancy caused by the resignation of G. E. Emmons, as vice-president in charge of manufacturing and chairman of the manufacturing committee. Mr. Pratt's new title will be vice-president in charge of engineering and manufacturing. H. F. T. Erben has been appointed assistant vice-president on the staff of Mr. Pratt. He will continue as vice-chairman of the manufacturing committee. Mr. Pratt's engineering assistant is E. W. Allen, appointed to the position of manager of the engineering department in April, 1924.

S. D. Hutchins, representative of the Westinghouse Air Brake Company at Columbus, Ohio, died on January 5 in the Mt. Carmel Hospital, following an operation. Mr. Hutchins was born at Cleveland on May 25, 1855. He entered the service of the Springfield, Mt. Vernon & Pittsburgh, now a part of the Cleveland, Cincinnati, Chicago & St. Louis, in 1871, as a fireman, and was promoted to

engineman in 1873. On May 15, 1896, Mr. Hutchins entered the service of the Westinghouse Air Brake Company as assistant on its air brake instruction car, and in 1905 was promoted to the position of representative, with headquarters at Columbus, which position he held until his death.

E. B. Perry, vice-president and general manager of the Industrial Works, with headquarters at Bay City, Mich., has been elected president and general manager to succeed W. L. Clements who has been elected a member of the board of directors. H. H. Perry, assistant to the vice-president and general manager, has been promoted to manager. C. R. Wells, secretary and treasurer, has been elected a member of the board of directors and will be succeeded by N. D. Platt, office manager, who in turn will be succeeded by J. L. Trudell, advertising manager, who will be succeeded by A. R. Olson. Walter Perry, superintendent, has been promoted to general superintendent.

The business of the T. H. Symington Company, manufacturers of railway equipment, has been conducted by a new corporation since December 17, 1924, organized under the laws of the State of Maryland, known as the Symington Company. The reorganization involves merely a readjustment of capital coincident with the placing of Charles J. Symington, who for five years was president of the T. H. Symington Company, in complete control of the policies of the new company. Including the election of Donald Symington, first vice-president; J. A. Sauer, vice-president, and P. P. Meade, secretary-treasurer, all with offices in New York, the same management of the old company continues. LeRoy Kramer, vice-president, remains in charge of western sales, with headquarters at Chicago, and Robert H. Gwaltney, vice-president, remains in charge of eastern and southern sales, with headquarters at New York. The operation of the Symington Company's works at Rochester, N. Y., will continue in charge of Donald S. Barrows, operating vice-president.

Safford S. DeLano, treasurer of the American Car & Foundry Company, New York, died at his home, 137 Riverside Drive, New York City, on December 27. Mr. DeLano was born in Waverly, N. Y., on January 24, 1856, and received his education in the public schools of Towanda, Pa. He entered the employ of the Michigan Car Company, Detroit, when sixteen years of age, and was advanced steadily until September, 1892, when a consolidation with the Peninsular Car Company was effected under the name of Michigan-Peninsular Car Company and he was appointed assistant treasurer of the new company. In 1899, upon the formation of the American Car & Foundry Company, the Michigan-Peninsular Car Company entered the consolidation, and in 1900 Mr. DeLano became a director and comptroller. In 1901 he was appointed treasurer, holding that office continuously until his death. He was also a director and treasurer of the American Car & Foundry Export Company and treasurer of the Sligo Furnace Company.

S. S. DeLano

The National Car Wheel Company and the Southern Wheel Company have been merged and are now operating under the name of the Southern Wheel Company, which is a subsidiary of the American Brake Shoe & Foundry Company. The merged company has plants at Pittsburgh, Pa.; Rochester, N. Y.; Cleveland, Ohio; Sayre, Pa.; St. Louis, Mo.; Birmingham, Ala.; Atlanta and Savannah, Ga., and Portsmouth, Va. The general offices are in the Keystone building, Pittsburgh, Pa., and the officers are as follows: W. F. Cutler, president, New York City; Frank C. Turner, first vice-president, Pittsburgh; J. Brookes Spencer, vice-president in charge of sales, Pittsburgh; C. C. Esdale, operating vice-president, Birmingham; C. M. Bower, vice-president, New York City; H. E. McClumpha, operating vice-president, Pittsburgh; J. Francis Weisbrod, assistant vice-president, Pittsburgh; Andrew Muirhead, treasurer, Pittsburgh; W. M. McCoy, controller, New York City; E. C. Hof, assistant controller, Pittsburgh, and G. M. Judd, secretary, New York City.

The Bethlehem Steel Corporation celebrated its 20th anniversary on December 10. During its 20 years of progress the management has adopted a policy, in acquiring new plants, of dividing and subdividing work so that each plant makes special steel products selected in accordance with the layout of the plant, the supply of raw materials and the market for the products. As a result, the corporation has an ingot capacity sixty times greater than it had in 1904 and only eight times as many employees. In 1904 the entire ingot capacity, all of which was in one plant, amounted to 120,000 tons a year, while at the present time the capacity amounts to 7,600,000 tons, distributed among seven steel plants.

George E. Doke, engineer of materials and equipment tests of the New York Central, at New York, has resigned his office and has been elected president of the Association of Manufacturers of Chilled Car Wheels, with headquarters at Chicago, to succeed George W. Lyndon, who died on October 7 in Chicago. George E. Doke was born in Tecumseh, Mich., on August 19, 1877, and was educated in the elementary and high schools of Elkhart, Ind. From 1897 to 1900 he served on the Indiana, Illinois & Iowa (now a part of the New York Central). He also served on the Lake Shore & Michigan Southern as yard clerk, telegrapher, bill clerk and timekeeper. He then entered the shops of the Lake Shore & Michigan Southern as an apprentice, and while serving in this position completed a special course in mechanical drawing and mechanical engineering. In 1905 he entered the chemical and physical laboratory of the Lake Shore & Michigan Southern at Cleveland as a laboratory assistant, becoming chief material inspector of that road's material inspection force in 1906. In 1912 he was promoted to assistant engineer of tests in charge of the locomotive and car department's service tests, and in 1916, following the consolidation of the Lake Shore & Michigan Southern with the New York Central, was promoted to assistant engineer of tests in charge of material inspection for the car and locomotive departments for the New York Central System. Four years later he was promoted to engineer of materials, with headquarters at Cleveland, Ohio, in charge of materials inspection and the creation and development of material specifications, and two months later was made engineer of tests of the New York Central Railroad in New York City, in charge of chemical and physical laboratories, material inspection bureau, service test department and dynamometer car tests. Since 1922 he has served as engineer of materials and equipment tests of the New York Central Railroad, in which position he has had charge of the service test department, dynamometer car tests, examination of failed materials and the creation and development of the equipment engineering department's material specifications. Mr. Doke for several years past has been an active committee member of the American Society for Testing Materials and the Mechanical Division of the American Railway Association. He is also a member of the Cleveland Engineering Society and the American Society of Mechanical Engineers.

George E. Doke

The Okonite Company has opened an office at 310 South Michigan avenue, Chicago, and has taken over the sale of Okonite products in the western territory. Charles E. Brown, vice-president of the Central Electric Company, has been appointed vice-president in charge of the territory west of Pittsburgh and east of the Rocky Mountains of the Okonite Company, with headquarters in Chicago. A. L. McNeill, manager of the railroad department of the Central

Electric Company, has been appointed manager of the railroad department. E. H. McNeill, railroad sales representative of the Central Electric Company, has been appointed sales engineer. Roy N. Baker, railroad sales representative of the Central Electric Company, has been appointed sales engineer. L. R. Mann, sales representative of the Central Electric Company, with headquarters at St. Louis, has been appointed manager of the St. Louis office. Joseph O'Brien, railroad sales representative of the Central Electric Company, has been appointed sales representative, with headquarters in Chicago. C. E. Brown, Jr., country sales manager of the Central Electric Company, has been appointed manager of the light and power department.

Manning, Maxwell & Moore, Inc., New York, has made the following changes in personnel in its sales organization, machinery department: Joseph Wainwright, district sales manager at Philadelphia, Pa., has been appointed eastern sales manager, with headquarters at New York; D. M. McDowell has been transferred from the New York office to the Philadelphia office as acting district sales manager; W. A. Deems, formerly master mechanic, Baltimore & Ohio Railroad, has been appointed sales engineer to cover eastern and southeastern territories. A new sales office has been opened at Los Angeles, Cal., with J. Fontes in charge of that office. Thomas A. Rees, formerly with Motch & Merryweather and the Treadwell Engineering Company, is now salesman at the Pittsburgh office. James W. Barr, formerly with the American Tool Works and the Van Dyck-Churchill Company, and Herbert S. Lester, formerly with the Hendey Machine Company, are now salesmen at the New York office. The sales force at the Buffalo office has been increased by the addition of C. O. Watson, formerly of Syracuse, and Henry I. Knickerbocker has been appointed general office manager, machinery department, in the New York office.

The Superfuel Corporation, New York, has been organized and has acquired control of the stock of the Trent Process Corporation, which owns the United States and foreign patent rights to the process of manufacturing an amalgam of fuel oil and bituminous or pulverized anthracite coal, which eliminates to a large extent the ash and clinker forming content of the coal. This product is now produced by several companies operating under license. Guy M. Standifer, identified with Pacific coast shipbuilding interests, has been elected president, and Francis R. Wadleigh, formerly United States fuel distributor, and commercial engineer of the U. S. Department of Mines and head of the Coal Division of the U. S. Department of Commerce, has been elected vice-president and general manager. J. A. Vandegrift, president of the Slope Mountain Coal Company, is also a vice-president, and Frank R. Peyton, secretary and treasurer of the Trent Process Corporation, is secretary and treasurer. In addition to Messrs. Standifer, Wadleigh and Vandergrift, the following have been elected as directors: Charles M. Barnett, president, Clinchfield Navigation Company, New York; R. M. Atwater, Jr., consulting engineer, New York; Walter E. Trent, combustion engineer, Washington, D. C., and Charles L. Parmelee, consulting engineer, New York.

F. A. Merrick, vice-president and general manager of the Canadian Westinghouse Company, has been elected vice-president and general manager of the Westinghouse Electric & Manufacturing Company. He will have general executive charge of the activities of the parent company, with offices at East Pittsburgh, Pa. The office of President E. M. Herr has been moved to the Westinghouse building, New York. Frank A. Merrick received his technical education at Lehigh University. Shortly after graduation he served with the Steel Motors Company, a subsidiary of the Lorraine Steel Company, and later became chief engineer. He subsequently joined the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa., where he had charge of the production of street railway motors and after the formation of the Canadian Westinghouse, Ltd., in 1903, he was its superintendent, and later became manager of works and finally vice-president and general manager. During the war Mr. Merrick had charge of the factory of the New England Westinghouse Company, which was engaged in turning out rifles for the Russian government, and later supplying the United States with machine guns. After the war Mr. Merrick was located in London for two years as special representative of the Westinghouse Electric International Company, and then returned to Canada to resume his original duties as vice-president and general manager

Trade Publications

Pipe threading machines.—The characteristic features of Williams pipe threading machines are listed in a bulletin recently issued by the Williams Tool Corporation, Erie, Pa.

Chain block.—The Morris worm-gear chain block built for loads of 2,240 lb. to the ton, is described in a six-page, illustrated folder issued by Herbert Morris, Inc., Buffalo, N. Y.

Mono-rail cable conveyor.—A six-page, illustrated folder descriptive of the newly designed American mono-rail cable conveyor for handling coal, has been issued by the Conveyors Corporation of America, Chicago.

Steel mine timber.—Tables and data on the properties and uses of mine timber sections are included in the 46-page booklet descriptive of steel mine timber, which has been issued by the Carnegie Steel Company, Pittsburgh, Pa.

Machine tools.—A four-page guide for the selection of a variety of makes, types and sizes of re-manufactured machine tools, has been issued by Hill, Clarke & Company, Chicago. About 2,000 machines, including lathes, drills, boring machines, planers, millers, etc., are listed.

Fabroil gears.—The General Electric Company, Schenectady, N. Y., has issued a four-page folder descriptive of fabroil gears which have been designed to cushion transmission shocks and to eliminate the noise incident to the operation of machines equipped with metallic gears.

Portable electric hoists.—Bulletin 76-E, descriptive of single drum and double drum portable electric hoists, which are modeled on the turbinair compressed air hoists of similar type and are interchangeable in operation and many particulars of design and construction, has been issued by the Sullivan Machinery Company, Chicago, Ill.

Compressed air equipment.—A 16-page booket, entitled "You Can Do It Quicker with Air," has been issued by the Sullivan Machinery Company, Chicago. Steel work riveting, wood and metal drilling, spray painting and other compressed air operations are featured, as well as the portable air compressors and air equipment used in the performance of this work.

Engineering achievements.—An attractive 52-page brochure, Publication No. 1717, entitled "The Engineering Achievements of the Westinghouse Electric Company during 1924," has been issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. As the name implies, the publication is a record of many of the major achievements of Westinghouse engineers in various fields, including railway traction.

Welding and cutting apparatus.—Welding and cutting apparatus manufactured by the Burdett Oxygen & Hydrogen Company, Chicago, and sold under the trade name "Burco" is described in a new 32-page catalogue issued by this company. The catalogue describes both oxy-acetylene and oxy-hydrogen welding and cutting apparatus and explains in detail the function of the Burco multiple mixer in promoting efficient flame propagation. Different types of torches with their respective parts are shown, also regulators and tank connections. Two full-page illustrations of particular interest to railroad men show the use of a Burco welding torch in building vestibules for passenger coaches and a cutting torch used in scrapping car frames.

The chilled iron car wheel.—A 68-page book, the object of which is to disseminate information as to the manufacture and service of car and locomotive wheels has been published by the Association of Manufacturers of Chilled Car Wheels, Chicago. The superior qualities of the chilled wheel are pointed out and discussed in detail. The various methods and operations used in manufacturing car wheels followed by a technical discussion of the various methods of inspecting and testing car wheels are thoroughly discussed. The importance of the proper machining and mounting of the wheels is emphasized. The various defects which the wheels develop while in service and the agencies for improving the manufacture of chilled car wheels are two factors discussed at length. The subject matter is well illustrated.

Personal Mention

General

D. S. ELLIS has been appointed assistant engineer of the New York Central, succeeding W. L. Lentz.

E. P. MOSES has been promoted to general equipment inspector (rolling stock) of the New York Central.

J. E. ENNIS has been appointed general equipment inspector (motive power) of the New York Central.

E. H. TROTTNOW has been appointed assistant engineer of rolling stock of the New York Central, succeeding E. P. Moses.

W. S. LAMMERS has been appointed assistant valuation engineer of the Atchison, Topeka & Santa Fe, with headquarters at Topeka, Kan., succeeding F. H. Adams.

W. L. LENTZ, assistant engineer, has been promoted to engineer of motive power of the New York Central, with headquarters at New York, succeeding P. W. Kiefer.

K. F. NYSTROM, engineer of car design of the Chicago, Milwaukee & St. Paul, with headquarters at Chicago, has been promoted to engineer of motive power and rolling stock, with the same headquarters, a newly created position. Mr. Nystrom was born in Sweden in September, 1881, and graduated from a university in that country in 1904 as a mechanical engineer. He came to the United States in November, 1905, and was employed as a draftsman by the Pressed Steel Car Company in 1906. In February, 1909, he was employed by the engineering department of the Pullman Company. In September of the same year he entered the service of the Southern Pacific. He was appointed assistant mechanical engineer of the American Car & Foundry Company in June, 1911, and in July, 1912, was appointed mechanical engineer of the Acme Supply Company of Chicago. Mr. Nystrom re-entered railway service in September, 1913, when he was appointed chief draftsman in the car department of the Grand Trunk at Montreal, Que. He was appointed chief draftsman on the Canadian Pacific in November, 1918, returning to the Grand Trunk in January, 1920, to become engineer of car construction. Mr. Nystrom entered the service of the Chicago, Milwaukee & St. Paul in January, 1922, as engineer of car design.

K. F. Nystrom

F. H. ADAMS, assistant valuation engineer of the Atchison, Topeka & Santa Fe, has been promoted to mechanical valuation engineer, with headquarters at Topeka, Kan., a newly created position.

N. J. BOUGHTON, engineer of tests of the Missouri-Kansas-Texas, with headquarters at Parsons, Kan., has been promoted to mechanical engineer, with the same headquarters, succeeding B. B. Milner, resigned.

P. W. KIEFER, engineer of motive power of the Lines East and West of Buffalo of the New York Central, with headquarters at New York, has been promoted to engineer of rolling stock, with the same headquarters, succeeding F. S. Gallagher, deceased.

T. M. KIRKBY, mechanical assistant to the general superintendent of motive power of the Chicago, Milwaukee & St. Paul, with headquarters at Chicago, has been promoted to special representative with the same headquarters. Mr. Kirkby was born in Norway on July 4, 1883, and graduated from the University of Christiania. He has been employed in various capacities on the Chicago, Milwaukee & St. Paul since 1905, with the exception of the period from 1911 to 1916, when he worked in the mechanical department of the Duluth & Iron Range at Two Harbors, Minn., as draftsman. He returned to the Chicago, Milwaukee & St. Paul in July, 1916, as draftsman in the mechanical engineer's office, with headquarters at Milwaukee, Wis., being subsequently promoted to chief draftsman in 1918, shop schedule engineer of the Milwaukee shops in 1920, and mechanical assistant to the general superintendent of motive power, with headquarters at Chicago, on January 1, 1922. He held the latter position until his recent promotion as special representative to the general superintendent of motive power.

Master Mechanics and Road Foremen

GEORGE E. DOUGHERTY has been appointed master mechanic of the Buffalo division of the Delaware, Lackawanna & Western, with headquarters at East Buffalo, N. Y.

J. J. KELLER has been appointed assistant master mechanic of the Salt Lake division of the Southern Pacific, with headquarters at Sparks, Nev., succeeding J. E. Stone.

J. E. MORRIS, general foreman of the Florida East Coast, has been appointed master mechanic, with headquarters at New Smyrna, Fla. This is a newly created position.

W. W. JONES, JR., general foreman of the Florida East Coast, has been promoted to master mechanic, with headquarters at Buena Vista, Fla. This is a newly created position.

J. E. STONE, assistant master mechanic of the Salt Lake division of the Southern Pacific, with headquarters at Sparks, Nev., has been promoted to master mechanic of the Salt Lake division, with headquarters at Ogden, Utah, suceeding D. Hickey, who has retired.

W. C. MILAR, night foreman of the Eola roundhouse of the Chicago, Burlington & Quincy, has been appointed road foreman of engines, with headquarters at Aurora, Ill., succeeding J. S. Ford, whose appointment as assistant master mechanic of the Galesburg division was noted in the January issue of the *Railway Mechanical Engineer*.

Car Department

F. SUDDETH has been promoted to night foreman of the Atchison, Topeka & Santa Fe, succeeding M. L. Hartigan.

WILLIAM GOVERT has been appointed master car builder of the Gary division of the Elgin, Joliet & Western, with headquarters at Kirk yard, Gary, Ind.

A. L. MERRILL, car foreman of the Atchison, Topeka & Santa Fe, at Argentine, Kan., has been promoted to a similar position, with headquarters at Emporia, Kan.

R. B. CRAIG has been appointed general car foreman of the Atchison, Topeka & Santa Fe, with headquarters at Chanute, Kan., succeeding L. H. Klein, who has retired.

M. L. HARTIGAN, night foreman of the Atchison, Topeka & Santa Fe, has been promoted to car foreman, with headquarters at Argentine, Kan., succeeding A. L. Merrill.

Shop and Enginehouse

P. P. CURTO, day roundhouse foreman of the Atchison, Topeka & Santa Fe, with headquarters at Gallup, N. M., has been promoted to division foreman.

E. J. CYR, day foreman of the Eola roundhouse of the Chicago, Burlington & Quincy, has been appointed general foreman, with headquarters at Centralia, Ill.

RALPH WILSON has been transferred from Richmond, Cal., to Gallup, N. M., as day roundhouse foreman of the Atchison, Topeka & Santa Fe, succeeding P. P. Curto.

P. P. HETTINGER, roundhouse foreman of the Chicago, Burlington & Quincy, with headquarters at Aurora, Ill., has been promoted to foreman of the Eola roundhouse, succeeding E. J. Cyr.

G. V. HEMMER, assistant supervisor of production of the Chicago, Burlington & Quincy, at Chicago, has been promoted to roundhouse foreman, with headquarters at Aurora, Ill., succeeding P. P. Hettinger

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Increased efficiency of shop operation

An article on another page of this issue describes the operation of the Finley locomotive shops of the Southern Railway at North Birmingham, Ala. It is an excellent illustration of what may be accomplished by proper inspection and control of labor and material expenditures. These shops have been in operation for approximately five months. During that time, a reduction of from 45 to 50 per cent in labor and material expenditures has been accomplished for Class 3 repairs as compared to the cost of performing the same kind of repairs in the old shops which the new plant has superseded. A large proportion of this reduction is due, of course, to the installation of modern machine tools and shop facilities. However, this reduction would be considerably less if it were not for the functioning of an efficient system of inspection and control of labor and material expenditures. The quality of workmanship and rapidity of production is checked by frequent inspections throughout the day, and by weekly meetings of the supervisory forces. Labor and material expenditures are checked by a daily report which is laid on the master mechanic's desk each morning. This work requires a minimum of clerical assistance; in other words, the overhead cost has not been increased in order to reduce the cost of shop operation.

There are, undoubtedly, numerous shops in which similar systems are in operation and excellent results being accomplished. It is not, however, a universal practice and mechanical department officers in charge of shops performing classified repairs will find many constructive suggestions in the system in operation at the Finley shops.

It's the little things that count

Marked improvements in locomotive performance are, in the majority of instances, brought about by persistent attention to what are often looked upon as relatively unimportant details of operation. The reduction in the number of pounds of fuel used per thousand gross ton miles for freight service and per passenger car mile in passenger service is a factor to which attention is being directed by the majority of mechanical and operating officers. In many instances elaborate road tests are often undertaken at great expense in an effort to discover methods whereby fuel saving may result. The real opportunity to accomplish this is quite often obscured by an effort to determine a single factor by changing which, the result can be obtained. On the other hand, attention concentrated upon a number of small elements in every day operating practices may produce a cumulative saving which will be greater than could be accomplished by a single radical change. Elsewhere in this issue will be found an article dealing with the methods which have been followed for the past several months on the Chicago Great Western which during the third quarter of the past year resulted in an actual saving in fuel consumption of 13.5 per cent per 1,000 gross ton miles in freight service and 9.9 per cent per passenger car mile in passenger service. The methods used were successful in reducing the number of pounds of coal consumed per 1,000 gross ton miles in freight service during the above mentioned period from 172 in 1923 to 149 in 1924, which performance compares very favorably with the fuel records made by other roads handling a similar class of traffic. There was an actual saving of $62,609.43 during this period, all of which was attributed to the nine methods outlined in the article. These methods are worthy of thoughtful consideration and it will be interesting to watch the results obtained by their continued use when future figures for fuel performance on the Chicago Great Western are available.

Take the circular letter seriously

It is the general practice on most railroads to issue from time to time circular letters which contain instructions pertaining to some phase of railway operation. Although these letters are issued in all departments of the railroads, we are chiefly concerned with those put out by the mechanical department. There is an old adage to the effect that for everything done, there is a reason, and the circular letter is no exception. The background for many of these letters is the consistent failure of certain parts of a locomotive or car. These failures are thoroughly investigated to ascertain the cause and the remedy, and the results are set forth in a circular letter for the purpose of instructing the mechanical department as to what procedure to take to overcome these defects. Again it is often found that the workmen are incorrectly making repairs which ultimately lead to failures. In order to standardize the methods of making repairs, a circular letter is issued which sets forth the correct practice to be used. Changes in safety appliance rules often result in the issuance of this form of instructions, which are of vital importance as they act as a safeguard to those using safety appliances such as grab iron, steps, etc.

It should be realized by those for whom the letters are intended that they are compiled at a considerable expense. Considerable time is expended in making investigations and tests in order to ascertain just what instructions these letters should contain.

But, after they are issued, do they serve their purpose? We will assume that the master mechanic and his foremen understand and fully appreciate the purpose of the letters, but do the workmen for whom they are primarily intended? They are generally placed on the bulletin board with the understanding that the men will read them. No

doubt the men do take the time to read them, but do they understand them and do the supervisors know that they understand them?

The mechanical officer in charge of the shops must first make sure that the supervisors under him thoroughly understand the meaning of the letters. They in turn, must determine by personal interview whether the workmen can interpret the instructions given in the letters. Thus, if these letters are understood by all those concerned, car and locomotive failures should decrease, with a corresponding reduction in maintenance costs. Otherwise, they might as well not be issued.

Proper maintenance of machine tools

Why is it that the general practice in railway shops is to run machine tools until they completely break down? Why is it that in the final analysis the mechanical officers find that the cost of machine tool maintenance is considerably more than it ought to be? One reason, and perhaps the most important, is that with attention concentrated on keeping cars and locomotives in repair they overlook the needs of their shop tools until the matter is forcibly brought to their attention by a failure which takes a machine completely out of service.

A supervisor of shop equipment should be made responsible for the proper maintenance of all machine tools. He should have a record of the history of every machine tool under his charge. This record should be kept from the date of purchase of each machine and should include information pertaining to the parts liable to failure along with the date and the character and cost of every repair made.

This officer should provide an organization to take care of every shop containing machine tools. In the larger shops, repair gangs should be organized, the duties of which are to look after the machines in the shops for which they are held responsible. For the small shops one man may be designated to look after the machine tools. He may be included in the millwright gang, but should report to the supervisor of shop equipment. This officer should solicit the co-operation of the foremen in charge of the shops, for it is to their advantage to eliminate machine failures. Again, the foremen should solicit the co-operation of each machine operator for it is to his advantage that his machine be kept in constant operation, particularly if he is working under a piecework or bonus system.

Now, the purpose of this organization is to keep a constant vigilance over the machines to prevent breakdowns and to anticipate failures of the parts most likely to give way. Regular periods of inspection could be advantageously established, at which time the repair men should carefully go over each machine in order to ascertain if there are any parts needing renewal to insure against failure. As time goes on, the officer in charge of this work will have a comprehensive record of the performance of each machine. If a certain part of a particular type of machine is the one that always fails, he should decide whether it is advisable to carry this repair part in stock or whether it would be cheaper to make it in the shops. The best of judgment and common sense will have to be exercised in deciding as to what repair parts should be kept on hand as a considerable sum of money could be quickly tied up in these parts.

It has generally become an established fact that the lack of the proper maintenance of locomotives and cars results in heavy repair costs. Is this just as true with respect to machine tools? Just as the human body needs to be examined carefully and prescribed for by a doctor before rather than after it breaks down, so does the machine tool require timely inspection and proper repairs.

An opportunity —and a challenge!

The following table, taken from an editorial which appeared in a recent number of the Railway Age, is deserving of the most careful thought and study by those who are interested in the continued development and prosperity of the railroads and the communities served by them.

Year	Average number of employees	Wages: Average	Wages: Per cent (*)	Cost of living (In December of each year) (*)	Net ton miles per employee (revenue and non-revenue)	Passenger miles per employee
1913	1,759,000	$761	100	100	186,503	19,258
1916	1,647,097	892	117	118	234,574	20,998
1917	1,732,876	1,004	132	142	248,309	22,779
1918	1,841,575	1,419	186	174	238,872	23,168
1919	1,913,422	1,486	195	199	206,837	24,233
1920	2,022,832	1,820	239	200	211,210	23,158
1921	1,659,513	1,666	219	174	205,340	22,477
1922	1,626,834	1,623	213	169	228,608	21,801
1923	1,855,260	1,619	213	173	245,950	20,462
†1924	1,780,772	1,610	212	170	240,260	20,507

†Estimate based on first eleven months of 1924.
*1913 = 100.

The railways have almost the same number of employees today as they had in the year 1913. These employees are relatively much better paid now than they were 12 years ago, as is indicated by the fact that while their wages have increased 112 per cent, the cost of living has increased only about 70 per cent. The individual employees are apparently giving a better account of themselves, as measured by the increase in the net ton-miles of freight per employee, or the passenger miles per employee, particularly if we take into account the shorter working day. There is, however, some question as to just what part of this increase is due to a greater degree of co-operation on the part of the employees, or to the exercise of a greater degree of individual effort on their part. There has been an increase in property investment of between five and six million dollars in this time, a considerable part of which has undoubtedly been used for facilities and equipment primarily designed to promote more efficient operation. There is little question, also, but what improved methods and practices have been responsible for a much better utilization of equipment and rolling stock.

Railroad managements have no control over the rates which they charge for passenger or freight service, or as to the wages which they pay the employees. They have been handicapped in many of the states and communities by restrictive regulations and legislation of a questionable nature. Taxation has increased at a rapid rate—for the past four years taxes have exceeded the amount of money paid out in dividends. Although the Interstate Commerce Commission was instructed by the Transportation Act to see that the railroads were allowed to earn a reasonable return, they have not, since the Act became effective, been allowed to earn anywhere near as much as the rather low percentage which was established by Congress as reasonable.

The railroad managements are anxious to make additional improvements in the plant and facilities, but their credit has been so impaired that it has been difficult to secure money for these improvements. Most roads have already issued too large a proportion of bonds as compared to the amount of stock outstanding. Something must be done to further improve their credit in order that they may be able to sell stock at par and secure funds with which to carry on improvements which will make for increased efficiency and improved service.

There is probably not a mechanical department officer on any of our railroads but could show where the expenditure of money for much needed improvements would

pay splendid returns. The question is where to get the money with which to make these improvements.

What can the management do to secure a greater utilization of equipment and enlist the interest of all of the employees in cutting out inefficiency and waste and making the best possible use of their energies? Have we given all the attention that we should to getting the best service from all of the workers in the organization—officers and foremen as well as the men in the ranks? Do all of the employees understand the relation of the railroad to the continued prosperity and development of the country? Do they take a real pride in the railway for which they work? Are they doing all they can to boost it and to help in a constructive way to improve its service and to operate it more efficiently and economically?

The art of management is a most complicated problem. Research and study have done much in recent years to reduce it to a science. This does not mean that it must be applied in a mechanical fashion according to certain rule or formulæ. It does mean that the officer with some natural executive ability can greatly increase his effectiveness by getting a better understanding of how best to deal with his fellows and lead them. No more striking development has taken place on the railroads in recent years than the growing understanding of the importance of giving more attention to the human element, and the fact that the interests of the employees, the managements, the public and the investors are mutual.

Never were the conditions so favorable for developing a greater degree of co-operation on the part of all concerned. The responsibility is clearly up to the officers and foremen to make the best of this opportunity and to use all their tact and diplomacy, and the growing fund of valuable information that is at their disposal for developing and improving their leadership ability. With the rates at which the railroads must sell their products and the wages they pay fixed by government agencies, and with the other restrictions that are placed upon them, this would seem to be the only avenue which will lead them out of the difficulties with which they have been so sorely beset for many years.

Steam for blower lines

One considerable fuel waste which can be eliminated or at least reduced at most engine terminals is in connection with the steam blower lines. The amount of steam utilized in these lines and consequently coal burned to generate it in the course of 24 hours, is totally unappreciated except by those who have made a study or test of the actual consumption. As a result, the importance of keeping blower lines tight, insulating them and using blower tips of the correct design and correctly placed to produce the greatest draft in the locomotive front end is often overlooked. Tests made some months ago at the Western Avenue, Chicago, enginehouse of the Chicago, Milwaukee & St. Paul indicate the rate of discharge of steam into the atmosphere at varying steam pressures from blower pipes of different sizes. For example, at 125 lb. pressure, steam will be discharged through a 3/4-in. pipe at the rate of about 107 boiler hp.; through a 1-in. pipe, 188 boiler hp.; through a 1 1/4-in. pipe, 294 boiler hp. The velocity and hence effectiveness of the escaping steam as a draft inducer increases rapidly with the gage pressure up to 75 lb. or possibly 100 lb. when the increase is more gradual and uniform. Most engine terminal blower lines consist of 1/4-in. pipe which, with unrestricted volume back of it at 150 lb. gage pressure, will discharge steam at the rate of 345 boiler hp. On account of the smaller pipe commonly used in the drop lines, much less steam than this is actually used. However, the test showed that with a boiler gage pressure of between 125 and 150 lb. the average steam consumption of the blowers is not less than 50 boiler hp. Figuring 6 lb. of coal for a boiler hp. hour and with the blower on for 45 min., this represents about 225 lb. of coal. The entire practice regarding the methods and equipment for blowing up locomotives can well be reviewed at many engine terminals to make sure that avoidable fuel wastes are not being incurred daily.

New Books

Diesel-Electric Locomotives for Standard Gage Railway Service. *By Dr. Eng. Herbert Brown, Baden, Switzerland,* 68 *pages. Published by Ernst Waldman Press, Zurich, Switzerland.*

This short treatise, in German, considers the possibility of utilizing the Diesel motor for locomotives. In the first general part the currently proposed methods of power transmission—direct drive, change gears, electric and the combined Diesel-steam locomotive—are mentioned and the outlook for the possible application of each discussed. In the second part follows a more detailed study of the Diesel locomotive with electric transmission, which the author considers to be the most promising solution at the present time. The pecularities of the Diesel motor are discussed from the point of view of the demands which are made in locomotive service. Special stress is laid on the problem of cooling, which is discussed on the basis of the known laws of conductivity in so thorough a manner that the author's conclusions are applicable to the cooling problem generally, as well as to its special application on the Diesel engine. The author is a member of the firm of Brown Boveri, Baden, Switzerland.

Railway Pipe Fitters Handbook, *By Frank J. Borer, acting general foreman, freight car department, Central Railway of New Jersey,* 223 *pages, illustrated.* 4 1/2 *in. by* 7 1/2 *in. Price* $2.50. *Published by the Simmons-Boardman Publishing Company, 30 Church street, New York.*

This volume contains 19 well illustrated chapters which cover the subject of pipe fitting from every angle of interest for a practical man. The first nine chapters cover fundamental knowledge which every pipe fitter should know. They contain information pertaining to iron and steel pipe, pipe threading, various kinds of pipe fittings and holding tools, measuring pipe and fittings and the hot and cold bending of pipe.

The tools and methods used when stripping pipes from locomotives and cars are covered in chapters X and XI. The drilling and tapping of pipe is discussed at length in chapter XII which is well illustrated for the purpose of clarity. The important subject of shop inspection is next considered by the author. In connection with this subject the importance of air leaks and what they cost in actual money is clearly set forth.

The author leaves the car and locomotive for a time and goes into the subject of estimating radiation for steam and hot water systems. This is followed by a discussion of the various forms of radiating surfaces and how they should be covered, when necessary to prevent radiation. Chapter XXII covers in detail the various types of power cutting and threading machines. The care and repair of dies is also given consideration. The last chapter covers in a thorough and practical manner the specifications for the installation of all types of air brakes including the U. C. equipment. This chapter, if carefully studied, will provide the pipe fitter with sufficient knowledge of the subject to enable him to handle any kind of air brake repairs with dispatch. The book is concluded with an appendix covering instructions on pressure gages.

What Our Readers Think

Derailments of locomotives on curves

A number of letters have been received since the publication of an article, discussing derailments of locomotives on curves, in the December, 1924, and January, 1925, issues of the *Railway Mechanical Engineer,* in which questions have been asked relative to this subject. These questions have been referred to the authors and the questions and answers will be published in this and subsequent issues.—EDITOR.

A question

CLEVELAND, Ohio.

TO THE EDITOR:

The article on Derailments of Locomotives on Curves, part I of which was published in the December, 1924, issue of the *Railway Mechanical Engineer,* states that the greatest number of derailments of Santa Fe type locomotives is due to the number one drivers leaving the rail. Fig. 7, page 724, shows the reactions in the rockers of the engine truck, which I believe is a product of the Commonwealth Steel Company. Assuming that the Santa Fe type referred to in the article is equipped with this type of engine truck, do many derailments occur when the locomotive is running at low speed around curves or through frogs, neither the locomotive or track showing evidence of mechanical defects?

In the case of a Mikado type locomotive equipped with an engine truck of the constant resistance type, would you not be inclined to think that the horizontal thrust would be increased? What conclusion could be arrived at if a similar resistance device were used on the engine truck of a Pacific type locomotive? Occasional derailments of the engine truck have recently occurred on this road with Mikado type locomotives but none have occurred with the Pacific type.

At a recent derailment of Mikado type locomotive in which the engine truck had left the track, an officer of the maintenance of way department stated that he could easily lift one of the engine truck wheels by means of a bar. In this case is it possible that the load on the engine truck is not sufficient to withstand the vertical reaction of the horizontal thrust? Should the load on the engine truck be increased by moving the equalizer pin? A READER.

The answer

GREENVILLE, Pa.

TO THE EDITOR:

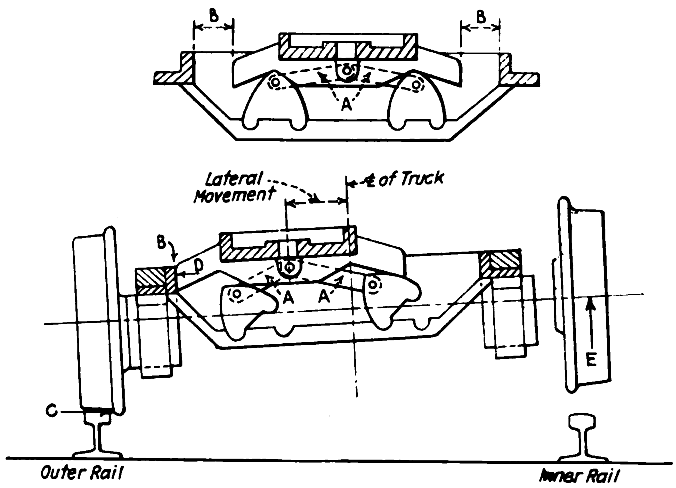
In the article referred to in the letter from "a reader," the authors chose to confine the discussion to the derailments of driving wheels. However, the statement was made that the same method could be employed for the investigation of the factor of wheel bearing on engine trucks as well. In order to do this, it is necessary to assign a calculated value to the horizontal component of the vertical load on the driving wheel and then solve for the vertical reaction on the engine truck wheel. From personal observation, it has been found that engine truck wheels seldom derail because the factor of wheel bearing is too low, but derailments occur more often on account of some rigid or defective condition in the truck.

The Santa Fe type locomotives referred to in the article, are equipped with Franklin Railway Supply Company's constant resistance engine trucks, sometimes known as the Economy truck which were formerly built by the Economy Devices Corporation. There is nothing inherently wrong with this type of truck, in fact it is a very good one, and gives satisfactory performance. Some derailments have occurred with these trucks, but in all cases, the causes have been discovered and corrected.

Referring to the upper figure of the sketch, one of the derailments was found to be due to the absence of the link *A*. This allowed one of the rockers to get out of place, causing a rigid condition of the engine truck which led to a derailment. It is important that these links, pins and cotters be carefully inspected and properly maintained.

Another condition sometimes found is that the clearance *B* is all taken up, which results in a rigid condition, making it practically impossible for the locomotive to round a sharp curve.

The most frequent cause of trouble has been found to be on account of the engine truck being out of square; that is, when one wheel leads the other. This is sometimes due to the radius bar being improperly made, or bent. For example, a case was found where a radius bar had been broken on one side and welded. The welded side was ¼-in. longer than the other, but this was not



Sketch showing the forces set up in an engine truck when all the lateral is taken up

discovered until a derailment had taken place. Sometimes the pedestals become bent, probably due to a previous derailment. In the case of a locomotive which was being derailed frequently, a ⅜-in. shim was inserted between the left back pedestal and the pedestal wearing plate which accomplished the desired result.

It is essential that the engine truck be carefully trammed and squared so that the wheels will line up properly. The distance from the front driver to the engine truck wheel should be the same on both sides and the center line of the engine truck axle should be at right angles with the longitudinal center line of the trucks through the radius bar pin. A condition such as this usually shows itself first in excessive wear of the flange on one wheel, but the condition which allows the flange to wear, also causes the wheel to crowd the rail on that side with the result that it is liable to derail on a switch or frog point or on a curve-worn rail. This condition is aggravated the sharper the flange becomes.

What has just been stated is not peculiar only to the Franklin Railway Supply Company's truck, but also applies to any two-wheel engine truck. This is a disadvantage of the two-wheel truck as compared with the four-wheel engine truck. Perhaps this condition may have something to do with the Mikado type locomotives be-

coming derailed on curves where the Pacific type gives no trouble.

Relative to the question on the horizontal thrust of the engine truck. The function of this thrust is to assist in the rotating of the driving wheel base. There must necessarily be enough weight on the outer truck wheel to overcome the vertical component of the horizontal thrust. One of the features of the engine truck is that the greater the curvature, the greater will be the weight on the outer wheel of the truck. There are some locomotives equipped with interchangeable front and trailing trucks. From conclusions resulting from this investigation, it is believed that this is a mistake, for if the trucks have the same side thrust and are approximately the same distances from the center of the locomotive wheel base, then the thrust of one will offset the thrust of the other. All the trucks will do is to carry weight and not assist in guiding the locomotive. The side thrust of the engine truck should be greater than that of the trailing truck in order to favor the locomotive while running forward.

The statement made by the officer of the maintenance of way department is undoubtedly true. Instances have been seen where the inside wheel of a two-wheel engine truck has risen off the rail as high as two inches, traveling through the air for some distance and then dropping back on the rail again. Being the inside wheel, no harm was done. This is caused by all of the clearance at *B*, in the lower figure of the sketch, being taken up, so that the thrust of the locomotive at *D* and the thrust of the rail at *C*, produces a couple which causes the reaction *E*, which, if the curvature is sufficiently great, will overcome the weight on the truck and lift the inside wheel from the rail or relieve it of enough weight so that it may be lifted by a bar. If the wheel does not rise, and the curvature is sharp enough, the flange of the outer wheel will break, the rail will turn over or the track will move in the ballast.

It may seem strange, nevertheless it is true, that there are some conditions at the rear of a locomotive that have a bearing on engine truck performance. It is sometimes a good thing to see if there is any fouling of the stoker trough, binding of buffer between locomotive and tender, tight safety chains, a fouled trailing truck, etc.

The track also has considerable bearing on the situation. The gage should be standard up to 8 deg. of curvature and then increased 1/8 in. for each 2 deg. up to a maximum of 4 ft. 9 1/4 in. The gage through frogs should be, regardless of curvature and the guard rail distance, maintained at 1 3/4 in. These figures are important and failure to maintain them properly is frequently the cause of a derailment.

ROY C. BEAVER,
Assistant mechanical engineer, Bessemer & Lake Erie.

Systematic terminal inspection of locomotives

PRESCOTT, Ariz.

TO THE EDITOR:

Good terminal inspection of locomotives has long been recognized as having an important bearing on locomotive performance as well as in reducing engine failures. I have known of instances where inspectors were allowed to us their own judgment as to the method of inspection. As a result, each man had a system of his own, or possibly, had no system at all, other than to commence at the front of the engine and inspect the several parts in the order in which they come and then go underneath the locomotive and follow the same procedure. With such a procedure the inspectors usually make note of defects as they are found, or depend upon memory until the whole locomotive is inspected before noting defects on paper.

Considering the size and tonnage rating of the modern locomotive something more than a general or promiscuous inspection of parts is needed. There is no doubt that a simplified system of inspection which will aid the inspector to concentrate on each part inspected will give better results. This can be accomplished by grouping the parts and concentrating inspection on each group separately; "O. K.ing" or making note of the defects found at the conclusion of the inspection of each group.

Noting on paper the results of the inspection of each part on a locomotive would necessitate a long itemized list. Checking each part as "O. K." or "Defective" is impracticable as well as cumbersome. However, inspection by groups has been found to be practicable. It requires

STATION__________ DATE__________1925

ENGINE INSPECTION REPORT

ENGINE #__________

GROUP No.		O. K. If No Defects
1.	Safety appliances	
2.	Cylinder and attachments	
3.	Revolving parts	
4.	Valve gear and attachments	
5.	Main and side rods	
6.	Cab and boiler attachments	
7.	Jacket, pipe work and fastenings	
8.	Steam, water and air valves	
9.	Engine and tender frames and attachments	
10.	Engine and tender trucks	
11.	Springs and brake gear	
12.	Driving boxes, shoes, wedges and binders	

DEFECTS TO BE REPORTED BELOW BY REFERENCE TO GROUP NUMBERS

____
Signature of Inspector.

Report form for inspectors—The various parts of a locomotive are assigned to groups to facilitate systematic inspection

little time and as the various groups become associated in the mind of the inspector, it insures more thorough inspection. It also gives him a check at the conclusion of an inspection by which he can assure himself that nothing has been overlooked.

Group inspection forms, like the one shown, can be made up into pads or in book form similar to the Car Inspector's Record book, which can be conveniently carried and used as a note book. The information on this form may be transferred to the work report form later.

The grouping of parts shown on the form has been found to be well suited for machinery inspection. The arrangement of groups is such that all the outside inspection can be completed before going underneath the locomotive. These groups can be rearranged or added to as desired. A similar grouping of parts may also be used to good advantage by boiler inspectors.

CHAS. RAITT,
Assistant master mechanic, A. T. & S. F.

Diesel-electric locomotive for freight service

Excellent results are obtained in a comparative test with a modern steam locomotive

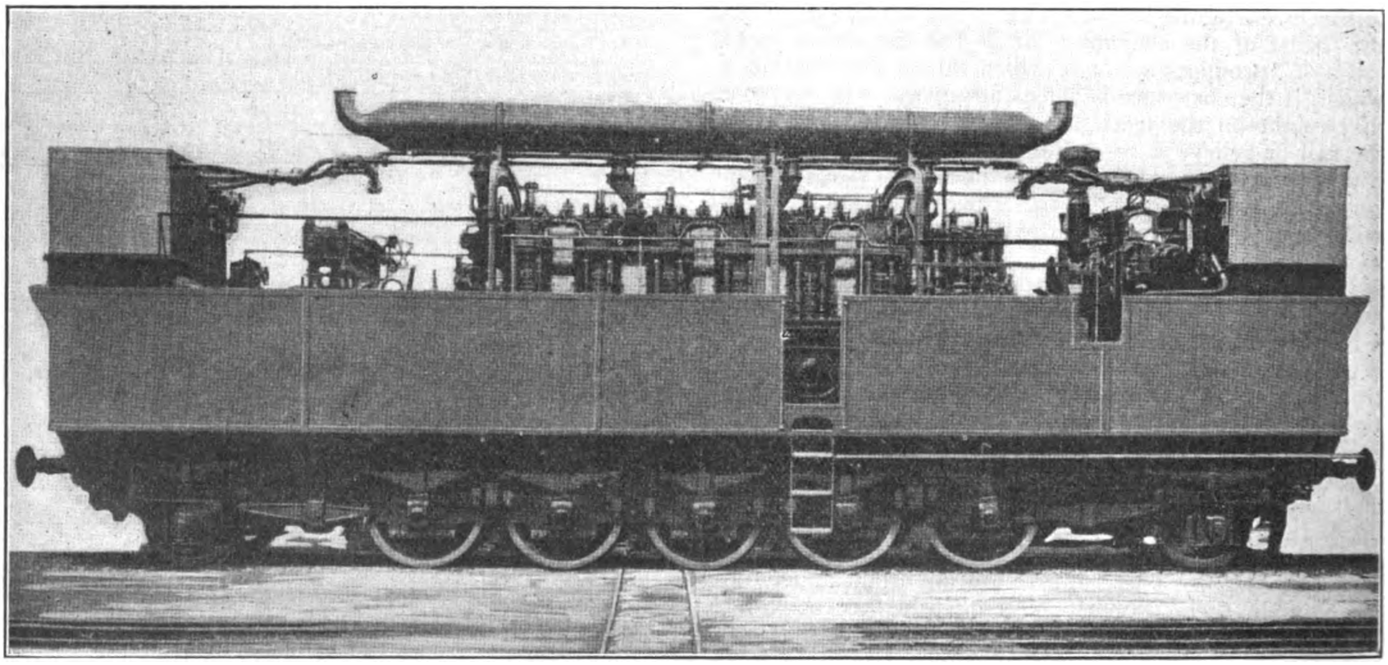
By Dr. J. Stumpf
Privy Counsellor, Berlin, Germany

PROF. GEORGE LOMONOSOFF, technical adviser on railway questions to the Russian government, and his staff have designed a Diesel-electric locomotive for the Russian government. It was built by the Hohenzollern Locomotive Works, Dusseldorf, Germany, at the Esslingen Locomotive Works in collaboration with the Augsburg-Nurulerj Machine Works and the machine works of Brown, Boveri & Company. The locomotive was tested on a device in Esslingen which was also designed by Professor Lomonosoff.

The engine is a six-cylinder, four cycle Diesel type and a result only the most reliable features were selected in the design of the four cycle, single-acting air injection and forced feed oil lubrication. Tests proved the electric transmission device to be most reliable.

The Diesel engine is generally supposed to be in continuous operation. Power is adapted to the requirements of the service by adjusting the voltage of the exciting current of the exciter dynamo. This control has proved to be close and reliable.

The testing plant on which this locomotive was tested is similar in design to that of the Pennsylvania at Altoona,



The engine is located at the center of the car with the air compressors at one end and a dynamo at the other

it is located on the center line of the car with the air compressors for oil injection on one end and a continuous current dynamo on the other. The current from the dynamo operates five motors connected by 1 to 6.14 gearing to each of the driving axles. The hot jacket water of the Diesel engine is cooled in a cooler which is located at one end of the locomotive. The water flows through a piping system cooled by a draft of air forced around the pipes by a fan. This cooler has sufficient cooling capacity to answer all requirements for ordinary air temperatures. However, when operating in hot climates, a second cooler, operated by an independent Diesel engine, may be located on a tender attached to the locomotive.

The cooling device was the most difficult problem in the design of the locomotive. In actual service the Diesel engine proved to be the most critical part, and as Pa. The drivers are run on wheels located in the casement and placed on shafts equipped with water cooled brakes at one end. A continuous adjustment of these interconnected brakes is necessary as the clutches of the brakes showed considerable wear and tear. Sand was always blown between the wheels to prevent slipping. The pull at the drawbar was taken up and measured by a dynamometer device. This, in connection with the circumferential speed of the driving wheels, disclosed the power developed by the driving wheels on the rails.

The resistance and speed were adjusted by the brakes to suit the conditions on the railway from Petrograd to the Caucasus, where the locomotive will later be in service. The first slope on this line is an ascending grade of 2.3 per cent which the locomotive is scheduled to cover in 55 min. The next slope is a descending grade of 0.5 per cent to be covered in 60 min. and the third slope is

an ascending grade of 6.3 per cent to be covered in 94 min. The speed in the three cases is to be 15.69 miles, 18.64 miles and 8.7 miles an hour with a pull at the drawbar of 19,845 lb., 9,922.5 lb. and 33,500 lb. respectively. At the end of the test an exaggerated load was put on the locomotive which brought the pull at the drawbar up to 44,100 lb. and the output of the Diesel engine up to 1,100 hp.

Excellent Results Are Obtained on the Test Plant

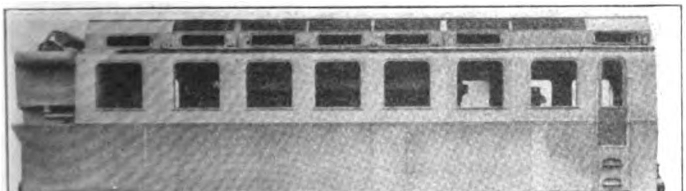
At 8:00 a.m. on November 4, 1924, the Diesel-electric locomotive was put in operation on the test plant. The first test began at 8:30 a.m. and ended at 9:25 a.m. The average drawbar pull was stated to be 20,062 lb., the average output to be 857 hp., the average oil consumption per horsepower hour to be .507 lb. or 42 per cent less than the .88 lb. stipulated in the contract between the Russian government and the Hohenzollern Locomotive Works. The average total efficiency was calculated from the following equation,

$$\frac{\text{circumferential work at the driving wheels}}{\text{heat value of the oil}}$$

which was found to be 27.4 per cent, a result which had never been reached before. The load was varied from 830 hp. to 880 hp. or about 6 per cent. The fan on the cooling tender was not in operation during the tests as the cooling apparatus on the locomotive was sufficient. The cooling water in this apparatus reached a temperature of 117.5 deg. F. with an air temperature of 51.8 deg. F.

The second test started at 9:25 a.m. and was finished at 10:25 a.m., in which time 250.12 lb. of oil were consumed. The average drawbar pull was 9,534.9 lb., the average speed was 18.4 miles an hour, the average capacity was 474 hp. and the average oil consumption per horsepower hour was .522 lb., or 41 per cent less than guaranteed. The average over-all efficiency was calculated from the previous formula to be 26.5 per cent. The load was varied from 440 hp. to 490 hp. or about 9.5 per cent. The fan on the cooling tender was not in operation.

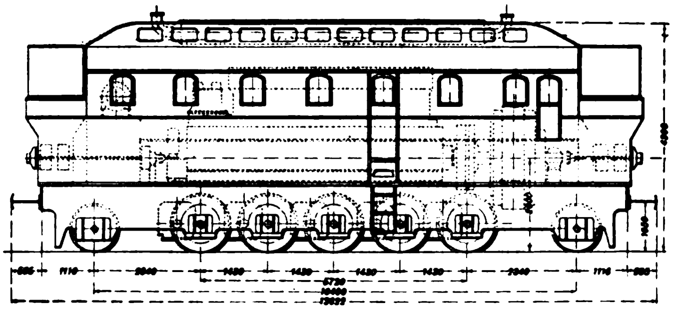
The third test started at 10:35 a.m. The load was



Diesel-Electric locomotive designed by Prof. G. Lomonosoff in collaboration with the Hohenzollern Locomotive Works, Düsseldorf, Germany

increased gradually between 10:25 a.m. and 10:35 a.m. and the test was completed at 12:09 p.m. During that time the main Diesel engine and the auxiliary Diesel engine which operate the fan on the cooling tender, consumed 767.3 lb. of oil. The average drawbar pull was 33,598 lb., the average speed, 9.82 miles an hour, the average output, 890 hp. and the average oil consumption .55 lb. per horsepower-hour, or 37 per cent less than agreed upon in the contract. The total efficiency was calculated to be 25.3 per cent. The load was varied during this test between 860 hp. and 944 hp. or 9.5 per cent. The fan on the cooling tender was in operation for 33 min. The water temperature, at the end of the test, however, was not higher than 150.8 deg. F. with an air temperature of 55.4 deg. F.

The last test was started at 12:09 p.m. and completed at 12:33 p.m. The fans of the cooling tender were in operation during the entire time, decreasing the water temperature from 150.8 deg. F. to 134.6 deg. F. The oil consumption of the main and auxiliary Diesel engine was 234.79 lb. The speed changed from 7.77 miles to 22.49 miles an hour with an output from the locomotive from 645 and 1,066 hp., and the over-all efficiency was calculated to be between 21.1 per cent and 24 per cent. The highest efficiency was stated to be 24 per cent at a



Elevation drawing of the Lomonosoff Diesel-Electric locomotive (Dimensions are in millimeters)

speed of 14.54 miles an hour. The temperature of the electric motors at the end of the test was 149 deg. F. The Diesel engine was stopped at 12:40 p.m. and all parts of the locomotive were found to be in good condition.

Heat values of the fuel oil were determined in the laboratory of the Technical University at Hullgard. A report was made at 3:00 p.m. which stated the upper heat value of the oil to be 42,700 B.t.u. and the lower heat value of the oil, which was Russian naptha, to be 39,820 B.t.u. These calculations were based on a heat value of 39,700 B.t.u.

Observers, consisting of approximately 50 prominent engineers of Russia, Germany and other European countries, who were attending these tests convened at 3:57 p.m. in the conference room of the Maschinenfabrik Esslingen. It was agreed that the Diesel-electric locomotive conformed to all of the stipulations in the contract, that the Diesel-electric locomotive was found to be completely reliable during the operation of 4.5 hrs., and that the low fuel oil consumption exceeded all expectations. The over-all efficiency was found to be between 21 per cent and 27.4 per cent at a load of between 440 hp. and 1,060 hp. during a part of which time the auxiliary Diesel engine on the cooling tender was in operation.

A comparative test with a steam locomotive, having five driving axles, was started at 8:00 a.m. on November 6, 1924. This locomotive was built by R. Wolf, Erfurt, Germany, and the boiler was built by Henschel & Son, Kassel. A membrane of the dynamometer broke at 8:04 a.m. It was the fourth fracture caused by the steam locomotive, whereas no fracture was experienced with the Diesel-electric locomotive. The membrane was replaced and the test was again started at 9:39 a.m. and completed at 10:36 a.m. The average drawbar pull was 19,999 lb., the average speed 15.35 miles an hour and the average output was 835 hp., with the power varying between 810 hp. and 869 hp. or 7 per cent. The boiler was heated with fuel oil, the consumption of which was 1247.8 lb. or 1.62 lb. per horsepower-hour, during the entire test. The total efficiency was calculated to be 8.67 per cent. The gage pressure of the boiler was 180 lb.

Without any interruption, a new test was started at 10:36 a.m. and completed at 11:35 a.m. The average

drawbar pull was 9,479.8 lb., the average speed 18.31 miles an hour and the average output was 468 hp. The output varying between 460 hp. and 505 hp. or 9.3 per cent. The oil consumption during the entire test was 855.5 lb. or 1.84 lb. per horsepower-hour. The over-all efficiency calculated as explained above was found to be 7.6 per cent. The gage pressure of the boiler was 170 lb.

A third test was started at 12:09 p.m. and completed at 12:50 p.m. The average drawbar pull was 31,900 lb., the average speed 10.56 miles an hour and the average output 910 hp., varying between 778 and 925 hp. or 18 per cent. The oil consumption during the entire test was 1,132 lb. or 1.83 lb. per horsepower-hour. The over-all efficiency was calculated to be 7.62 per cent. At the end of the test the gage pressure of the boiler was 180 lb. The test was interrupted on account of the spring of the safety valve on the front cover of one cylinder releasing and allowing a part of the steam to escape. At 12:50 p.m. the speed was brought up to 31.07 miles an hour. At 12:54 p.m. the locomotive was stopped and all parts, with the exception of the above mentioned spring, were found to be in order.

The observers convened at 3:25 p.m. and decided that this locomotive operating with the superheater could be considered as economical, as the total efficiency averaged between 7.6 per cent and 8.67 per cent. This locomotive did not have a feedwater heater. The fuel consumption of the Diesel-electric locomotive was about one third of the steam locomotive and it showed an unusual ease and flexibility of adjustment and also steady operation which should have a favorable effect on the rails.

The author believes that the Diesel-electric locomotive has been realized by the construction of this locomotive and the results of its tests at Esslingen. The engine may be considered as especially adapted for freight traffic. It also exhibits a favorable efficiency in the electric transmission. Professor Lomonosoff, however, does not consider this locomotive to be final, as he is planning to build another Diesel locomotive with spur gearing, for which the Krupp Company has guaranteed a machine efficiency of 96 per cent. As this efficiency is considerably higher than that of an electric transmission and also more simple and cheaper to construct, a Diesel locomotive equipped with spur gearing may be an improvement. However, the flexibility in adjustment is considerably less and a change in gear ratio is not at all safe while running.

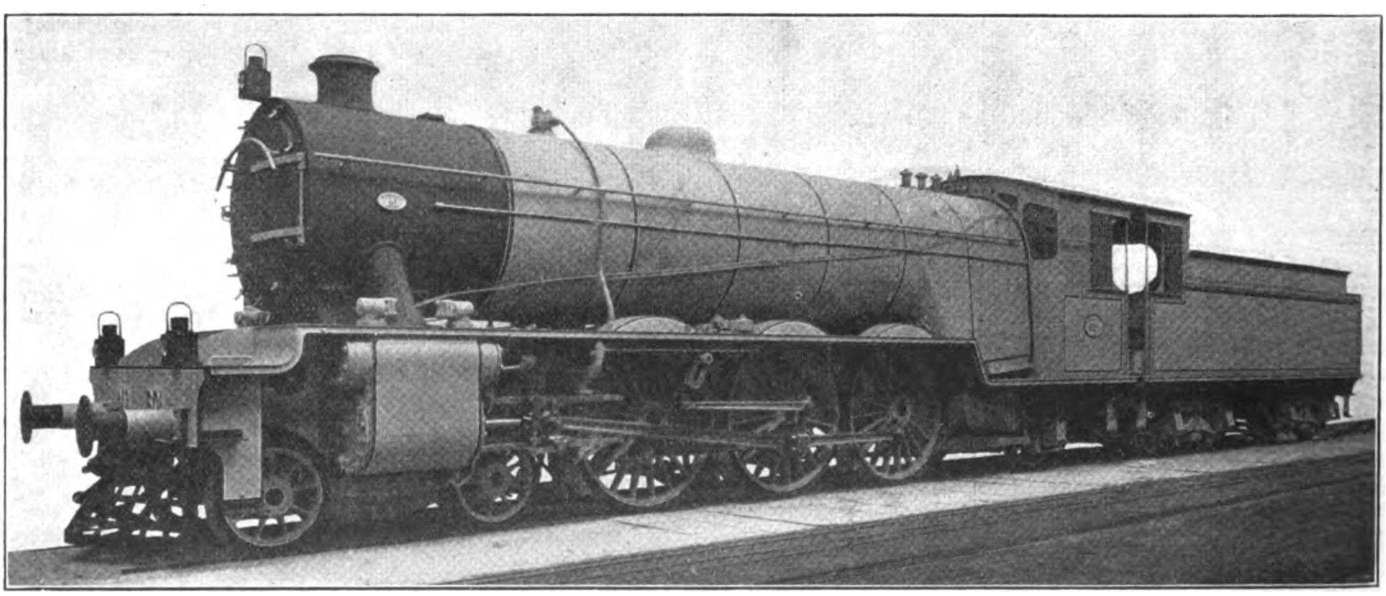
Broad gage locomotives for India

Largest and most powerful two-cylinder types ever built for service in that country

By E. C. Poultney

THE two large locomotives which are shown in the illustrations are examples of new types recently supplied to the Bombay, Baroda and Central India for heavy traffic on the broad gage (5 ft. 6 in.) section of that system.

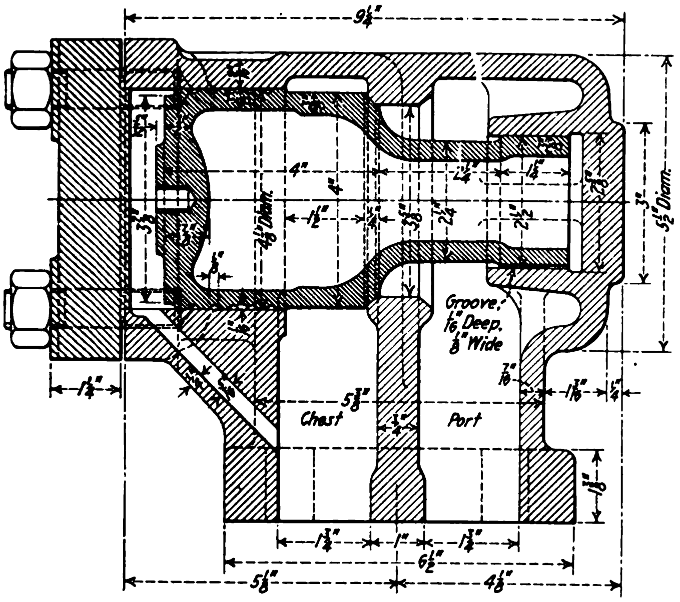
With the exception of some 2-10-0 freight locomotives placed in service on the Great Indian Peninsula about 1921 having four cylinders, each 20 in. by 26 in., a tractive force of 50,000 lb., a total combined heating surface of 3,585 sq. ft., and weighing, without tender, 241,875 lb., these new locomotives are the largest and most powerful so far built for any of the Indian railways. The two locomotive types described here are alike in many important details, the chief differences being that one is of the Pacific type having 74-in. drivers for passenger service, and the other is a Mikado with 56½-in. drivers for heavy freight service. In the design of both the engines and tenders interchangeability has been closely studied. The boilers with their



Pacific type passenger locomotive built for the Bombay, Baroda and Central India

fittings, grate bars and ash pans, are duplicates, as well as the cylinders, valve motion, pistons, piston rods, crossheads, connecting rods, driving boxes, spring rigging, and the trailing trucks. The tenders for both designs are alike in constructional details.

The boilers are of generous proportions, having a total combined heating surface of 2,909 sq. ft., of which 550 sq. ft. is contributed by the 30 element flue tube superheater, which is provided with the Marine and Locomotive Superheater



Detail of Hendrie by pass valve

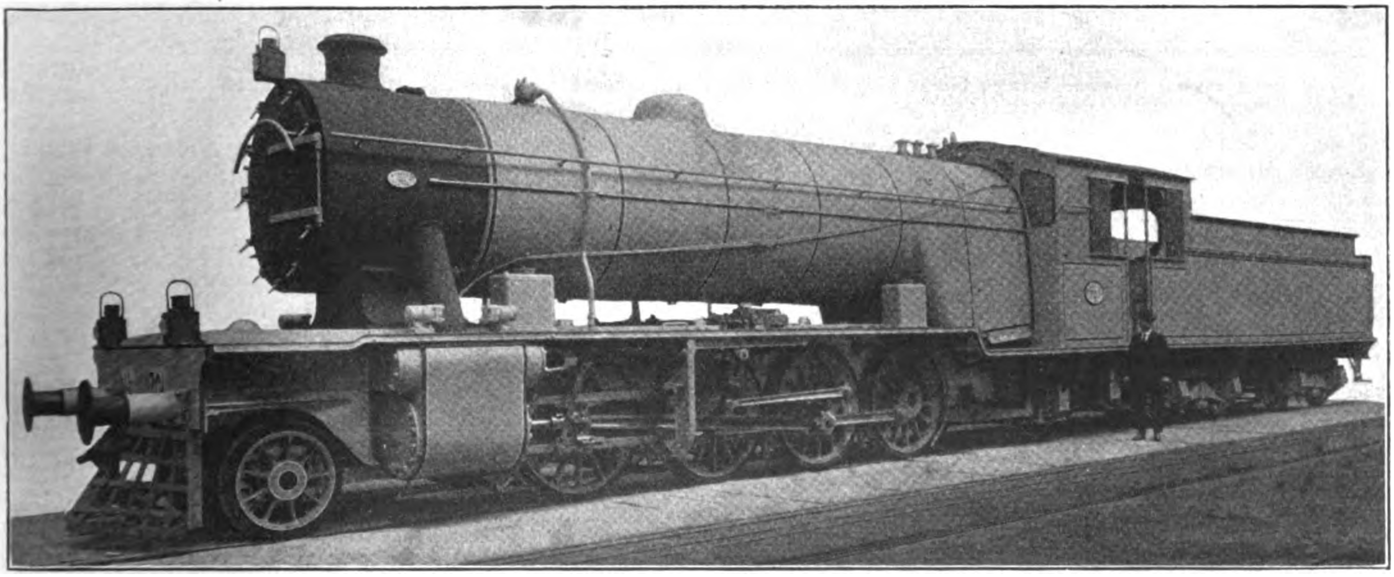
Company's Stirling type header. A large automatic air valve is fitted to the saturated steam side of the header, the function of which is to open when steam is shut off, thus allowing air to be drawn into the elements when drifting. This valve also acts as a vacuum breaker for the cylinders, which are equipped with by-pass valves that will be described later. A wide firebox is provided, giving a grate surface of 48 sq. ft., and the brick arch is supported by arch tubes, four in number. The internal firebox of copper is extended forward into the barrel section, thus forming a combustion chamber. The water space at the foundation ring is three inches at the sides and three inches at the front and back, and the one-inch diameter water space stays are of copper. The crown of the firebox and combustion chamber is supported by direct stays. The stays at the front next the tube sheet are so arranged as to permit of upward expansion. Rocking

Table of dimensions, weights and proportions

Type of Locomotive	4-6-2	2-8-2
Service	Passenger	Freight
Two cylinders, diameter and stroke	23 in. by 28 in.	23 in. by 28 in.
Valve gear, type	Walschaert	Walschaert
Valves, piston type, size	11 in.	11 in.
Weights in working order:		
On drivers	133,000 lb.	161,000 lb.
On front truck	40,000 lb.	17,500 lb.
On trailing truck	38,000 lb.	37,500 lb.
Total engine	211,000 lb.	216,000 lb.
Tender	165,000 lb.	161,000 lb.
Wheel bases:		
Driving	12 ft. 9 in.	15 ft. 9 in.
Total Engine	34 ft. 8 in.	33 ft. 9 in.
Total engine and tender	66 ft. 3½ in.	65 ft. 4½ in.
Wheels, diameter outside tires:		
Driving	74 in.	56½ in.
Front truck	36 in.	36 in.
Trailing truck	43 in.	43 in.
Tender truck	43 in.	43 in.
Journals, diameter and length:		
Driving	8¼ in. by 11½ in.	8¼ in. by 11½ in.
Front truck	6¼ in. by 9 in.	6¼ in. by 9 in.
Trailing truck	6½ in. by 11 in.	6½ in. by 11 in.
Tender truck	6½ in. by 11 in.	6½ in. by 11 in.
Boiler:		
Type	Straight top	Straight top
Steam pressure	160 lb.	180 lb.
Fuel	Bituminous coal	Bituminous coal
Diameter, third course	75 in.	75 in.
Tubes, number and diameter	130-2¼ in.	130-2¼ in.
Flues, number and diameter	30-5¼ in.	30-5¼ in.
Arch tubes, number and diameter	4-3 in.	4-3 in.
Length, between tube sheets	18 ft. 0 in.	18 ft. 0. in.
Grate area	48 sq. ft.	48 sq. ft.
Heating surfaces:		
Firebox, including arch tubes	239 sq. ft.	239 sq. ft.
Tubes	2120 sq. ft.	2120 sq. ft.
Total evaporative	2359 sq. ft.	2359 sq. ft.
Superheating	550 sq. ft.	550 sq. ft.
Combined evaporative and superheating	2909 sq. ft.	2909 sq. ft.
Tender:		
Water capacity, Imperial Gals.	6240	6240
Coal capacity	31,360 lb.	28,000 lb.
General data and ratios:		
Rated tractive force, 85 per cent.	27,200	40,100
Comb. heat. surface ÷ grate area	60.6	60.6
Firebox heat. surface, per cent of comb. heat. surface*	8.22	8.22
Superheat. surface per cent of comb. heat. surface	18.89	18.89
Tractive force x dia. drivers ÷ comb. heat. surface	692	778
Firebox heat. surface ÷ grate area**	4.47	4.47
Factor of Adhesion	4.88	4.01

* Firebox heating surface, including arch tubes.
**Heating surface, less surface of arch tubes.

grate bars are employed with a dumping section at the front end. A top feed arrangement is provided, water being



Large Mikado built for service in India on 5-ft. 6-in. track

supplied by two self-acting, re-starting injectors of reversible pattern. The boilers are protected by three safety valves set to pop at 160 and 180 lb. per sq. in. for the passenger and freight locomotives respectively.

The 23-in. by 28-in. cylinders are in separate castings bolted to the main frames, and between them is fixed a saddle casting on which the smoke box rests. Piston valves operated by Walschaert gear distribute the steam, and reversal is effected by a hand wheel and screw. The piston valves are arranged for inside admission, and outside steam pipes are applied as shown.

Each cylinder is fitted with two by-pass valves of the Hendrie pattern, a detail of which is shown in the drawing. These valves are very simple in construction, and each consists in this instance of a 4⅛-in. diameter valve working in a suitable annular cavity machined in the body casting, and so arranged that its inner end forms a valve seating on a port connecting the valve chest, live steam side, with the steam port. A passage way of 5/16-in. bore connects the outer end of the valve with the steam chest, so that when steam is admitted to the steam chest by the throttle each valve is held closed. When running with the throttle closed any vacuum formed in the steam chest causes the valve to be drawn from its seat, and connection is thus established between the steam chest and the cylinder at each end, irrespective of the position of the main piston valves. In this manner air may be drawn from the steam chests and elements through the air valve placed on the header casting, and as freely expelled. The lubrication of the valves and pistons is effected by a Detroit four-feed sight feed lubricator.

The springs are all of the usual type, placed above the driving boxes. The trailing trucks have boxes of the Cartazzi design working in curved guides. In the case of the Pacifics the trailing truck is equalized with the driving wheels, and on the Mikado the leading truck and first and second drivers form one group, the third and fourth drivers, with the trailing truck, forming another group.

Solid grease lubrication is used for the driving boxes, the system employed being the Franklin, and the lubricant is that supplied by the Galena Signal Oil Company, Ltd.

The automatic vacuum brake acts on the driving and tender wheels only. There are two 24-in. diameter brake cylinders on the engine and two cylinders 21 in. in diameter on the tender. The braking power for the Pacifics is equal to 72.3 per cent of the weight on drivers and for the Mikados is 71.5 per cent. On the tenders the braking power is equal to 97.2 per cent of the light weight.

The principal dimensions and the important proportions are appended in the tabulated statement.

Generally, these new locomotive types follow usual practice on Indian railways, and in appearance are similar to the standard types which have been in service for many years, though they are very much larger and of much greater capacity. It will be evident from a study of the dimensions and proportions that considerable care has been exercised in working out the designs, and it is reasonable to assume that these new locomotives should give an excellent account of themselves in service. The boilers are of considerable size, a most important feature, and their proportions indicate that they should steam freely.

The locomotives were built by Kitson and Company, Airedale Foundry, Leeds. The designs were prepared and the locomotives constructed under the supervision of Rendel, Palmer & Tritton, consulting engineers, Westminster, London.

How the Chicago Great Western controls use of locomotive fuel

RECORDS of coal consumption and engine failures on the Chicago Great Western show that desirable results in these two particulars have been secured within recent months. There was a saving in fuel consumption of 13.5 per cent per thousand gross ton-miles in freight service and 9.9 per cent per passenger car-mile in passenger service during the third quarter of 1924 as compared with the third quarter of 1923. During the same period engine failures were materially reduced. The following are some of the methods used to attain these results: (1) Competition between divisions with cash prizes for the best fuel performance; (2) educational work by means of bulletins, a rotating illuminated sign in the dispatcher's office and study of a book on correct fuel handling methods; (3) careful attention to water conditions and cleanliness of boilers; (4) use of modern locomotive appliances for reducing fuel consumption; (5) holding locomotives under fire as little as possible; (6) careful attention to the grade of coal used; (7) competition between divisions, crews and enginehouse forces regarding engine failure records; (8) critical analysis of all causes of engine failures.

Fuel saving on the Chicago Great Western for the third quarter of 1924 over the third quarter of 1923

	Tons of coal burned on freight locomotives		Tons of coal burned on passenger locomotives		Freight traffic in thousand gross ton-miles		Passenger traffic in passenger car-miles	
	1924	1923	1924	1923	1924	1923	1924	1923
July	31,049	36,213	10,930	12,186	419,245	433,497	1,449,063	1,479,084
August	35,634	36,891	10,862	12,599	494,303	425,681	1,484,444	1,538,858
September	36,539	38,001	11,526	12,266	469,118	427,748	1,482,510	1,406,258
	103,222	111,105	33,318	37,051	1,382,666	1,286,926	4,416,017	4,424,200

	1924	1923	
Lb. coal burned per thousand gross ton miles	149.3086	172.6673	Saving 23.3587 or 13.5 per cent
Lb. coal per passenger car mile	15.089615	16.749242	Saving 1.659627 or 9.9 per cent
Total estimated saving in 1924 freight service	16,148,64 tons		
Total estimated saving in 1924 passenger service	3,664.47 tons		
Grand total saving in 1924	19,813.11 tons at $3.16 a ton = $62,609.43.		

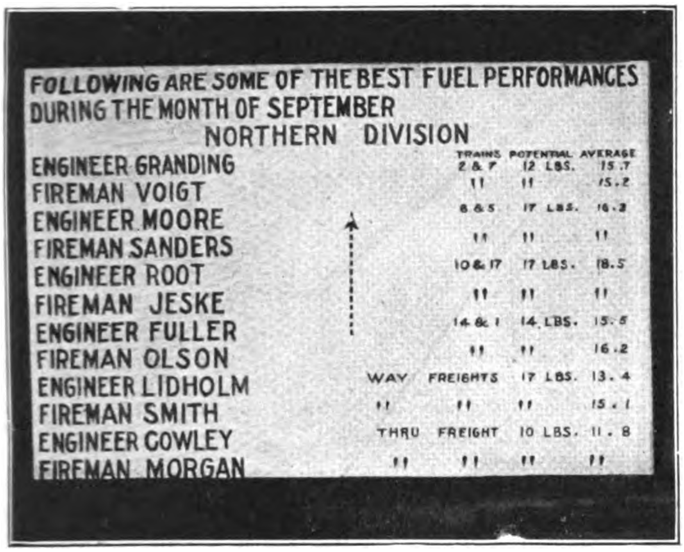
Competition and prizes

A cash prize of $500 is offered every three months for the operating division which makes the best showing in

fuel consumption in freight and passenger service in comparison with the potential consumption for the same period. This potential consumption is computed on a ton-mile basis for freight and on a car-mile basis for passenger service, being 10 per cent less than the actual consumption during the same period in the preceding year. In other words, the potential consumption is a goal or a mark to shoot at. During the third quarter of 1924 a saving of $62,609.43 was made in this service as shown by the attached table.

A cash prize of $200 is offered every three months for the division which makes the best showing in fuel consumption in switching service as compared with a potential consumption per switch engine hour. A saving of about 7 per cent in the amount of fuel burned per switch engine hour was effected in the third quarter of this year.

The results of this competition between divisions and



Rotating sign developed on Chicago Great Western for use in engineman's room; endless linen strip moves slowly in the direction of the arrow

the awarding of prizes have, therefore, been highly satisfactory. The prizes already awarded have been distributed and used largely for benevolent purposes through the brotherhood organizations.

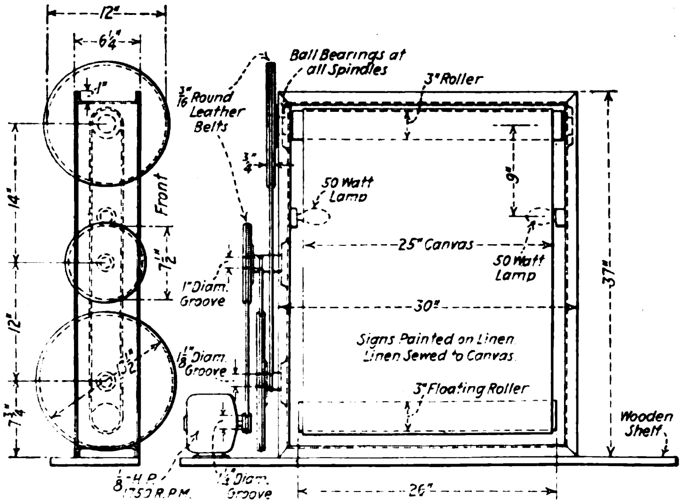
Rotating sign in dispatcher's office

One of the essential requirements in securing effective competition between the divisions is the posting of fuel performance records where they can be seen readily by the crews and others interested. At the enginehouse at Oelwein, Iowa, a rotating sign is used which shows these individual performances and which, on account of its unusual construction, creates a great deal of attention. This rotating sign is located in the enginemen's room on the wall next to the engine dispatcher's window. It consists of a wooden frame, about three feet wide by two feet high, with the performance of the various engine crews painted on an endless canvas-back linen strip which moves continuously from the bottom to the top of the frame. The direction of movement is indicated by the arrow in the illustration. The endless linen strip is driven over suitable rolls by the small electric motor, the rate of revolution being such as to permit easy reading as it moves upward. Two lights back of the wooden frame illuminate the linen strip thoroughly and this with the movement makes it the first thing to catch the eye on entering the room. It attracts attention immediately on opening the door and is frequently surrounded by a considerable group of enginemen and firemen who are anxious to find out what the other fellow is accomplishing. A healthy competition is thus stimulated.

Another factor which should be given partial credit for the fuel performance secured on the Chicago Great Western is the educational work which has been carried on by means of bulletins posted in conspicuous places showing the effects of poor firing and giving specific examples of good practice. Traveling engineers and firemen on each division instruct the crews and offer helpful criticism of their work. A book on the proper use of fuel has also been distributed by the management and this has proved effective in instructing the men in proper methods of firing and the economical use of coal.

Boilers kept clean

Special attention has been given to the treatment of water to eliminate scale so far as possible. Boilers are washed out carefully. On long runs such as the passenger run to Chicago and return, the boilers are washed after every other trip into Oelwein. On the trip that the boiler is not washed the water is changed. Practically all Chicago Great Western freight and passenger locomotives are equipped with superheaters and brick arches. Some of the Mikado and Santa Fe type locomotives have combustion chambers. Thermic syphons are being applied to consolidation locomotives as fast as they come into the shop for new crown sheets. One of the light Mikados has been equipped for purposes of test with a Worthington feed water heater. Good results have been secured with the Superior flue blower applied to a consolidation locomotive running on the Southern division. This effects a large fuel saving, as the locomo-



Details of the driving mechanism and lights for the rotating sign

tive can be run for six or seven trips without knocking the fire. It also makes a great saving in non-effective locomotive hours as the locomotive can be turned in about two hours over the cinder pit.

Every effort is made to have the transportation and the mechanical departments co-operate as closely as possible to avoid holding locomotives under fire in the enginehouse any longer than is necessary. This is checked closely and those responsible for any waste of this kind are severely criticized. All coal received is analyzed and efforts made to secure as uniformly good a grade as possible.

A comparison is made every month of the performance of the various divisions for the previous month as regards

engine failures. This statement shows the individual failures, their causes, the locomotives involved, the places where the failures occurred, amount of delay and the points from which dispatched. It also shows the miles run per engine failure on each division and in total and the per cent of failures to the total number dispatched.

Each failure is entered on a report known as the "Six A. M." report as it occurs. Thorough investigation is made of the persons involved and discipline administered to guilty ones. Broken parts, if any, are sent to the office of the superintendent of motive power and an analysis made to determine the cause of the break. In each case action is taken to attempt to prevent a recurrence of the failure. As a result of these investigations the design of certain locomotive parts may be changed to give more strength or instructions regarding application of the parts revised to correct maintenance methods which are not securing desirable results.

Stationary power plants for railroads

Careful analysis of power requirements facilitates proper selection of mechanical equipment

By Paul R. Duffey

THE modern railroad system has one principal commodity to sell to the public—transportation. To accomplish this economically and profitably is the ultimate aim. The principal agents used to carry on this business when once secured are motive power, rolling stock, tracks, etc., for the maintenance of which adequate facilities must be provided. Such maintenance facilities must depend upon energy in the form of heat and mechanical and electrical power for their successful operation. This naturally brings us to a consideration of the stationary power plant.

It is not the intention of this paper to deal so much with the efficiencies available in the plant, but to bring out the necessity of properly classifying the plants and bringing them up to certain points of standardization as compared to other units in the layout of shops, yards, etc.

From the standpoint of design, installation, operation and maintenance, stationary power plants and their allied facilities, deserve as much thought and consideration as any other important unit.

Classification of power plants

Class 1.—Plants of 1,200 to 2,500 b.hp. and above. On the average system from two to four plants of this size will usually be found located at main shops.

Class 2.—Plants of 800 to 1,200 b.hp. Plants of this capacity will be located at terminals with facilities for receiving and despatching 100 locomotives per 24 hours. Such size terminals usually have facilities for doing considerable car repair work.

Class 3.—Plants of 200 to 800 b.hp. Plants of this capacity are located at the smaller engine terminals, at ore and coal docks, grain elevators, and timber treating plants.

Class 4.—Plants of 100 b.hp. and under. Plants of this size are located at water pumping stations, coach and office heating plants, and for portable service.

We should now group our plants and their allied facilities in such a manner that a close standardization of plants can be established for those covered in Classes 2 and 3. Plants shown in Classes 1 or 4 call for further analysis.

After analyzing present requirements for the four groups of plants, we should add at least 25 per cent reserve to take care of increased requirements for the succeeding ten years after the plant is built.

At this point it is essential that we acquaint ourselves with the requirements of our plant and just what it serves. This leads us to consider the following:

1—THE PRODUCTION OF POWER

Generation of electric power—For turntable motors; coaling station motors; ash pit crane motors; transfer table motors; locomotive hoist and traveling crane motors; electric crane motors; shop motors for driving metal and woodworking tools; electric drills, hammers and fans; battery charging plants; general lighting for shops and yards; special motor-driven compressors and pumps, magnets, etc

Mechanical power—For steam-driven shop engines; steam-driven fan engines; boiler feed pumps; vacuum pumps; boiler wash and fill pumps; water supply service pumps; fire and emergency pumps; steam-driven air compressors supplying air to shop tools, car repair yards, train testing yard, to coach cleaning and painting of locomotives and cars, hoists and jacks, for blowing sand from dryers to storage bins, for lifting water and to operate signal systems and switches.

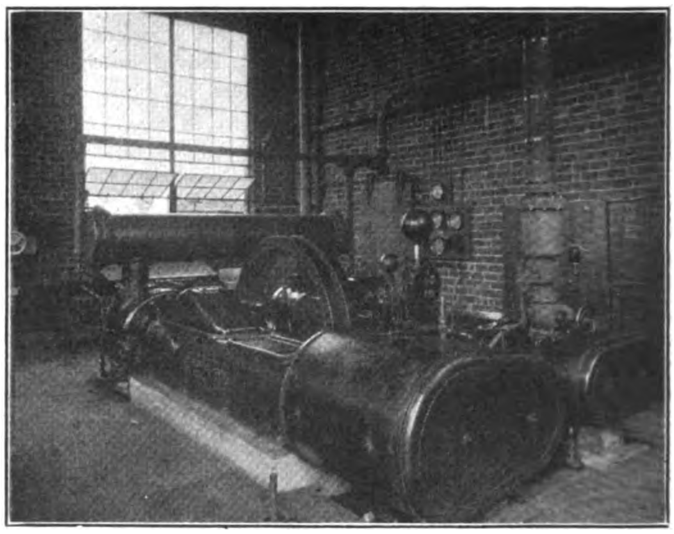
2—STEAM USED FOR ENGINEHOUSE BOILERS

3—STEAM FOR HEATING

Heating required continuously—Oil house and crude oil storage tanks, sand dryers, boiler washing plant, paint shops and dryer rooms, lumber dry kilns, and foundry drying ovens.

Heating required for the winter season—Shops and enginehouse, either by direct or indirect system; offices, storehouses, yard offices, etc.; passenger cars, and thawing devices.

The foregoing items cover the essential classes of service which the stationary plant is called on to serve. In this tabulation are items for which a plant of Class 1 size is required and in some cases a Class 4 plant will serve the purpose.



Air compressor installation featuring large single steam driven unit

Next we must consider the distribution of service and it is well to remember that in working out the distribution we should consider our summer and winter loads. A service distribution sheet should then be compiled to correctly show the charges to be made against the number of departments served by the plant, both on a winter and summer basis.

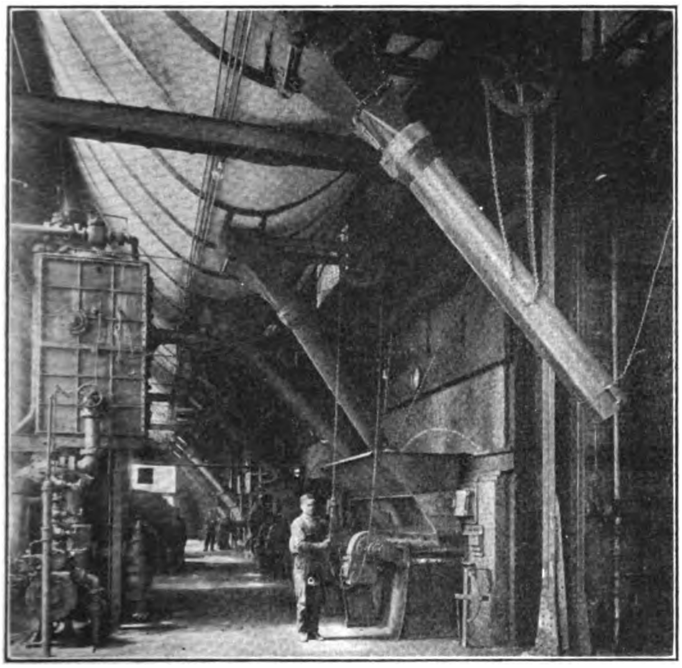
Such distribution sheets assist us in working out the size of the plant necessary to serve our purpose.

Owing to the fact that the majority of our plants range around 1,200 b.hp. and less, we will consider a plant in that class.

Power plant building

Location—The power plant should be located centrally with respect to distribution of steam, electric current, compressed air and water. Consideration should also be given to the handling of fuel to the plant and ash from the plant.

Construction—Hollow tile, reinforced concrete, or brick should be used in the construction of the walls; the roof trusses should be of steel; the roof of fire-proof construction, provided with ample ventilation for the entire length of the plant covered. Ample windows should be provided for natural lighting and ventilation, steel sash are recommended in preference to wood. Doors of ample size should be provided for handling machinery in and out of the plant. Crane runways should be permanently installed in all plants of over 1,000 b.hp.



Boiler plant equipped with vertical water tube boilers, stokers, overhead bunkers, continuous coal and ash conveyor, forced draft fan and feedwater heater

Power plant equipment

Boilers—Plants of the size under consideration are usually provided with either the horizontal return tubular boiler or boilers of the water tube type. When a plant reaches such capacity as to require six return tubular boilers (150 b.hp., capacity per boiler) it is quite justifiable to install water tube boilers of larger capacity instead of having a large number of small units.

Stacks—For plants of the size under consideration we should give attention to the erection of a reinforced concrete, or a radial brick stack. For the small plants (under 1,000 b.hp.) steel stacks are suitable, particularly where return tubular or locomotive type boilers are used. Such stacks should be not less than 40 in. diameter, 80 ft. high, built in sections 20 ft. long, material 1/4 in. thick, guy bands to be set away from the stack by using spacer blocks welded to the bands before they are fastened around the stack. This method will prevent water, fine ash, etc., from settling at this point and causing the stack to rust away. Stacks should be given at least two coats of fire proof paint before erection. Joints should be closely drawn to place before riveting and all rivets should be driven hot.

Coal and Ash Handling Facilities—For the size plant under consideration usually a trestle is built over a coal bin in front of the boilers, the coal being dumped into the bin direct from hopper cars. For handling ashes in this plant a steam jet conveyor is suggested. For more efficient methods of handling coal and ashes a continuous conveyor such as spiral screw, scrapers, pans, pivoted buckets and endless belts are worthy of consideration. In some cases hoists with a car or skip hoist may be found advantageous.

Feed Water Heating and Regulation—The use of a feed water heater is not only desirable but necessary. Feeding cold water to the boiler is not only uneconomical but detrimental to the boiler. The heater selected should be of ample size, and located in a convenient place near the feed pumps. The open type heater is well adapted to use in railroad power plants and as the construction is very simple, it is not difficult or expensive to maintain. Automatic feed water regulation is desirable and a number of regulators are on the market which have proved successful.

Feed Water Pumps—The ideal type of pump for boiler feeding is the multi-stage, centrifugal, turbine driven pump. However, in the size of plant under consideration we usually find duplex pattern steam driven, outside packed plunger type pumps used. In either case we should install pumps in duplicate units. Feed pumps should be installed on firm foundations and raised at least six inches off the floor. All piping to and from the pump should be the full size of openings provided on the pump. At least two feet clearance should be left around the pumps in order that repair work can be done without cramping the workmen in a small space. Feed pumps should be equipped with excess pressure governors and a water relief valve. Force feed lubricators are preferable to hydrostatic lubricators.

Air Compressors—In the selection of air compressors we have a wide range to choose from; steam driven, synchronous motor mounted direct on crank shaft or electric motor belt drive. Whatever equipment is selected should be of ample capacity. Pipe lines should be of substantial size. Air storage capacity should be amply provided and all such storage reservoirs should be provided with safety valves and a conveniently located drain valve. Where such facilities as pipe lines and storage tanks are liable to freeze they should be kept well drained and also provided with alcohol thawing apparatus.

Steam Engines—Due to the fact that the majority of railroad power plants are called upon to supply large quantities of low pressure steam for heating purposes the steam turbine is only used in the larger plants. For plants such as are under consideration the reciprocating type of steam engine is largely used.

The selection of this type of equipment should be carefully looked into and it is advisable to carefully analyze local conditions in each case. Besides the usual types of engines we find the unaflow engine coming into prominence and there is no doubt as to its being economical and worthy of more than passing note.

Power Plant Piping—The design and installation of power plant piping requires more than the amount of thought we sometimes care to give it and we should in no case lose sight of the following items: Size of lines; use of none but the best grades of materials and carefully separate as between low pressure, medium pressure and high pressure work; provide for proper expansion in steam and hot water lines; provide for proper drainage of all steam headers, to be trapped and the condensate returned to heater or boilers direct; all cut-out valves on boilers, engines and pumps should be located where they are accessible for operation and repair; wherever possible avoid placing pipe lines, fittings and valves in trenches, underground and similar unhandy places.

It is suggested in the larger size plants that the use of

welded headers and pipe be resorted to where possible, in order to eliminate joints and fittings. Welded work is in many cases not only cheaper in first cost but by eliminating the threaded joints and bolted fittings and flanges much longer life of pipe can be expected, with resultant reductions in maintenance costs.

Two methods of welded joints are suggested. One is a butt weld. In the second a sleeve or fitting is used which slips on over the pipe and is welded at each end to the pipe. This method is the stronger of the two and eliminates the formation of fins from welding inside the pipe.

All power plant steam lines, hot water lines, and return lines should be insulated with suitable pipe covering and where such lines are exposed to the weather they should further be protected by covering with roofing paper, canvas sewed on and painted or a galvanized iron jacket, the size and importance of the line to govern the method and kind of covering to use. Air lines buried in the ground should be covered first with one good coat of high grade asphalt paint; after this is dry apply a spiral wrapping of 12-ounce canvas secured at convenient intervals with No. 16 soft drawn copper wire; then give two coats of asphalt paint, and allow to dry before placing the pipe in the ground. Fittings should, where possible, be treated in the same manner.

Additional facilities

Boiler Washing and Filling Plant—This facility has developed so rapidly that it is now an indispensable part of our engine terminal equipment and owing to the necessity of successful operation it is usually taken care of by the power plant forces. The plant usually consists of two large wooden or steel tanks, one containing hot water for filling boilers of locomotives and the other tank contains warm water for washing boilers. In addition we have two duplex steam pumps, one used on the filling line and one on the washout line. We also have a separate line for blowing off locomotives under steam into the tank used for washing boilers. A special arrangement is used for separating the sludge of this blow back water in such a manner that mud will go into the sewer, water will go to the washout tank and the steam vapor will pass into the filling tank. Special float valves on the water lines and thermostatic controlled steam valves take care of the automatic features of the plant.

Fire Protection System—In the power plant we usually place the automatic fire alarm telegraph instrument, with a special code of signals to be sounded from the fire whistle when necessary. The fire pumps are also located in the power plant and such equipment should not only be kept in first class condition at all times but it should frequently be tested. Such facilities should not be used for purposes other than what they are intended for.

Steam Heating System—An exhaust steam heating system is one of the most important and economical parts of our stationary power plant and as it is called upon to furnish heat to shop buildings on an average of 212 days per year, it is one of the excuses we have to offer for maintaining steam driven facilities where cheap electric power can be purchased from central station service.

A well designed exhaust steam heating system is justifiable at all medium sized plants and even in the smaller plants in cold localities such a plant must be provided in order to keep the workmen comfortable.

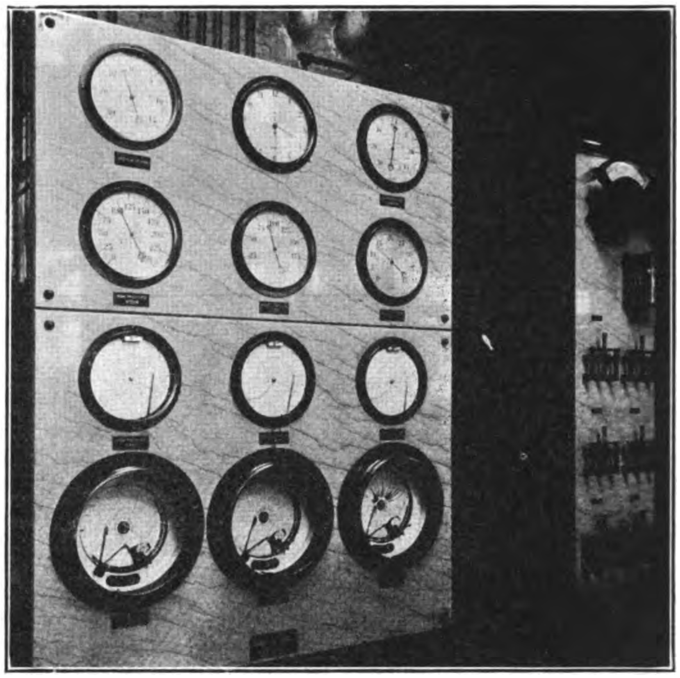
Condensate from the system is usually returned to the feed water heater or boilers by operating the system under vacuum, thus insuring proper circulation and draining of the heating elements at all times.

During the summer or idle period the plant should not be allowed to deteriorate but repairs should be made to all heating elements, valves, traps, vacuum pumps, fans and engines.

Operation and management

To obtain the greatest possible efficiency in power plants is not entirely a matter of design, but a great deal depends on proper operation and management.

In order to operate successfully we must build up an organization composed of a power plant. foreman, whose qualifications should be such as to specially fit him for the responsibilities of the important position he is to fill. The man selected should know power plant operation, how to handle men, how to do and pass on work done in the plant by boilermakers, machinists, masons and electricians. He must know how to indicate engines, set valves and make necessary adjustments; understand modern boiler and engine room instruments and their use in his plant. He should also understand the analysis of accounts entering into power costs. A foreman of this character is necessary to the successful operation of all plants over 1,000 b.hp.



An installation of indicating-recording instruments is a necessity for economical operation

In plants under 1,000 b.hp. the position of power plant foreman can be filled by the first shift engineer, this man to have an assistant engineer to relieve him of the operation of engines in order that he may devote more of his time to the details of efficient operation of the entire plant.

In the larger plants our next step in organization is the shift engineers, who are responsible for the successful operation of the plant.

Stationary firemen should be selected carefully and they should be instructed as to their duties in the boiler plant. Coal and ash handlers are primarily unskilled labor, yet in the larger plants this class of labor is usually promoted to better positions as they occur in the fire room, and for this reason some degree of consideration must be given to the selection of this class of help.

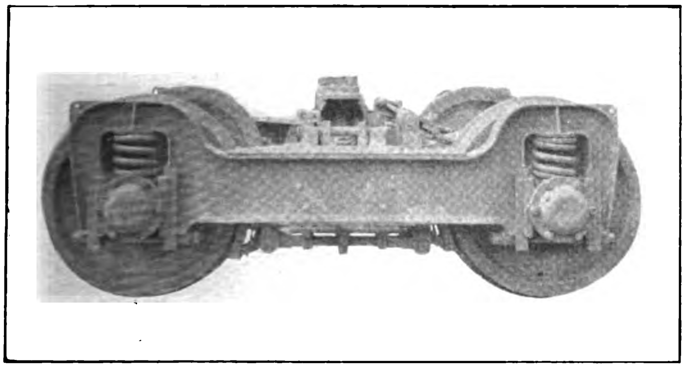
For each district on the railroad there should be at least one man on the staff of the district mechanical officer qualified to follow up all matters pertaining to steam-electric power plants. This supervisor should see that the plants are properly organized, efficiently operated and maintained.

Having built up an efficient operating force it is necessary next to consider the management of this force together with a well defined policy for plant maintenance. No one set of rules can be laid down to fit any two plants without some slight change, and it is not within the scope of this paper to go into details further than to say that the stationary power plant should receive the same consideration as any other unit.

Two-car gasoline motor train

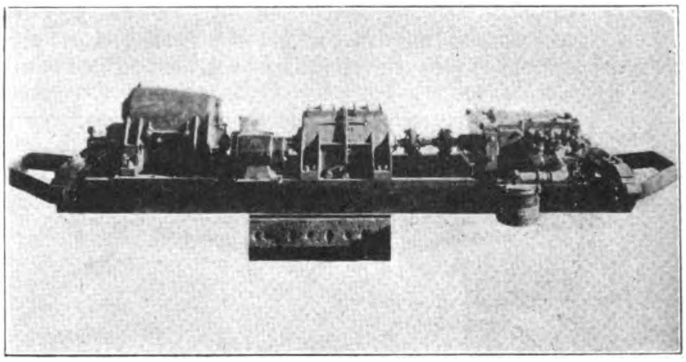
Big Four acquires a combination baggage and mail motor car and 60-passenger trailer for local service on main line

THE Big Four placed in service on Saturday, February 14, between Danville, Ill., and Mount Carmel, on the Cairo division, a two-car gasoline motor driven train, built by the Sykes Company, St. Louis, Mo. Four more trains of the same design are under construction for the Big Four. Two of them will be operated between St. Louis, Mo., and Mattoon, Ill., on the main line, and two between Matoon, Ill., and Indianapolis, Ind., on the main line—all in local service. The outstanding feature of this train is the combination mail and beggage car. This car is the first motor car of its type to have the sanction of the Post Office Department, some of the steam equipment standards of construction of the Department having been modified to meet the conditions of motor train service.



The four-wheel truck of the motor car

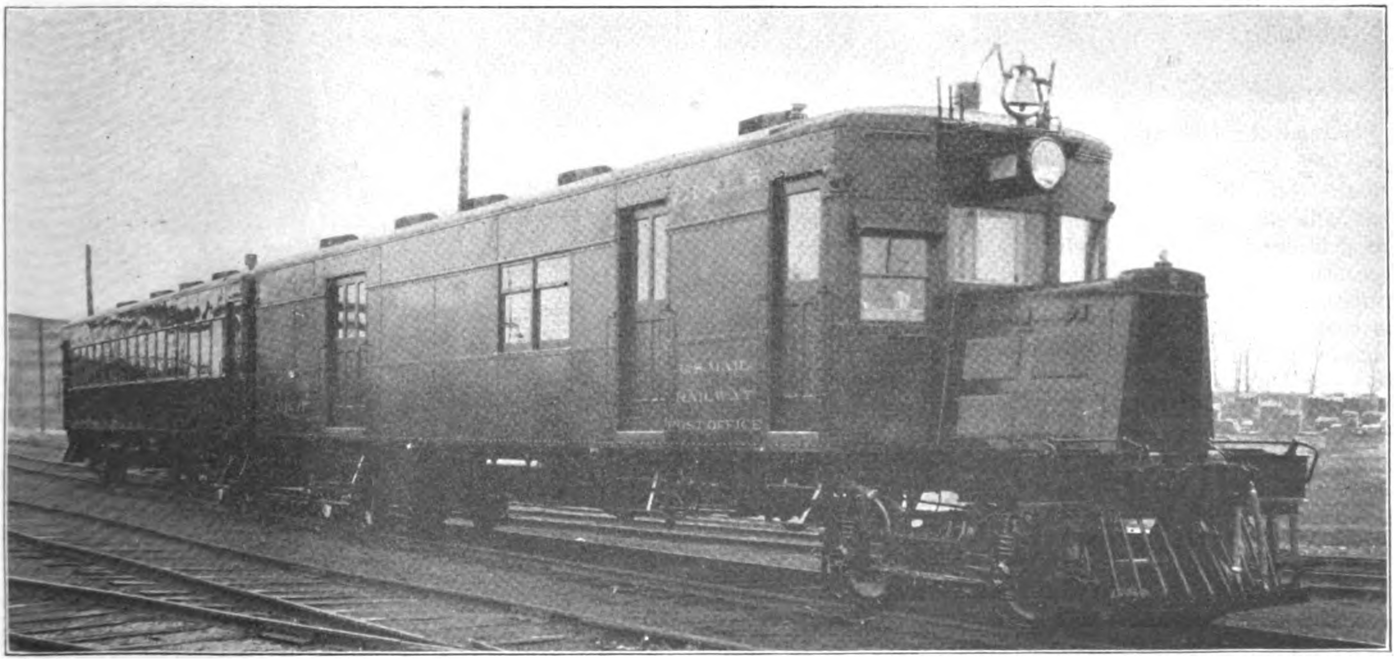
The train consists of a motor coach having a mail compartment, 17 ft. 3 in., long and a baggage compartment 23 ft. 2 in. long, and a trailer coach 51ft. 4¼ in. long, over all, in which seats are provided for 60 passengers. The motor coach is 51 ft. 9⅝ in. long overall, with a body 43 ft. 11 in. in length outside, and 8 ft. 4¼ in. wide at the eaves. The height over all is 12 ft. The trailer coach is 49 ft. 6 in. long over the body and 42 ft. ½ in. long inside of the passenger compartment. The inside widths of the motor and trailer coaches are 7 ft. 10⅛ in. and 7 ft. 11 in. respectively. The height from floor to ceiling of both cars is 7 ft. 7 in. and the elevation of the floor above the top of the rails is 3 ft. 10 in. The distance between truck centers is 37 ft. 2½ in. on the motor car and 33 ft. 6 in. on the trailer. The wheel base of the trucks is 5 ft. 2¾ in. and the cars are adapted to pass around curves of 200 ft. radius.



Transmission subframe assembly showing transmission units and two-cylinder air compressor

The light weight of the motor coach complete is approximately 42,000 lb. and of the trailer coach 29,000 lb. As the trailer provides seats for 60 passengers this is at the rate of 483 lb. dead weight per seated passenger.

The cars are driven by a Sterling six-cylinder gasoline



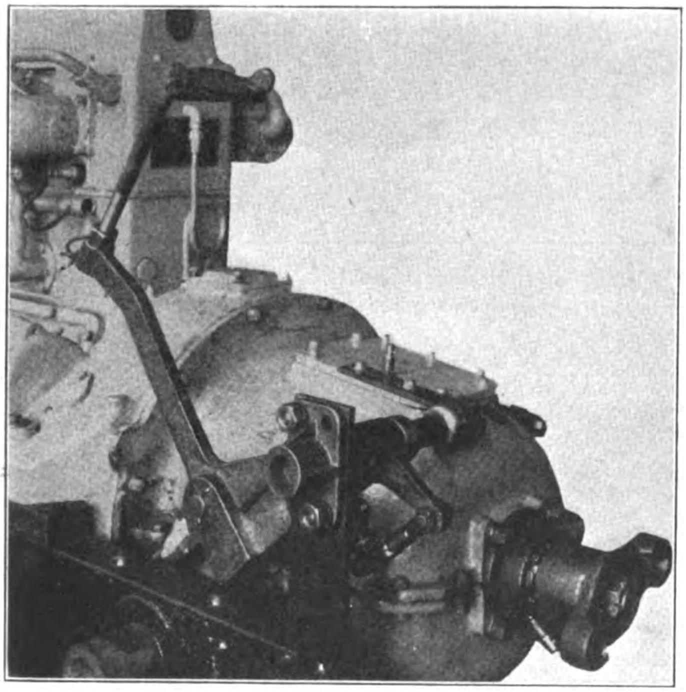
Big Four two-car motor train, built by the Sykes Company, with the motor coach designed as a combination baggage and mail car

motor with cylinders, 5¾ in. bore by 6¾ in. stroke, developing 180 hp. at 1,250 r.p.m. and 245 hp. at 1,750 r.p.m. Electric starting and lighting systems are provided, the generator being directly driven from the engine and of a sufficient capacity to carry all the lights of the train, including the headlight, and to keep the lighting batteries charged to capacity at all times.

A multiple plate, self contained, high capacity clutch is provided, which runs in oil. A special transmission, developed by the Sykes Company, is used. This is so mounted that the speed changing elements may be removed from the coach as a unit on a subframe. The transmission provides for four speed changes ahead, and two in reverse. The low speed gears have a 2-in. face. The third and fourth speed gears are of the herringbone type with 6-in. faces. The speeds provided for are 8.3, 16.7, 33.4 and 44.6 m.p.h. ahead and 7.8 and 10.4 m.p.h. in reverse. The drive is connected by bevel gears on the inside axle of each truck.

The clutch is operated by air

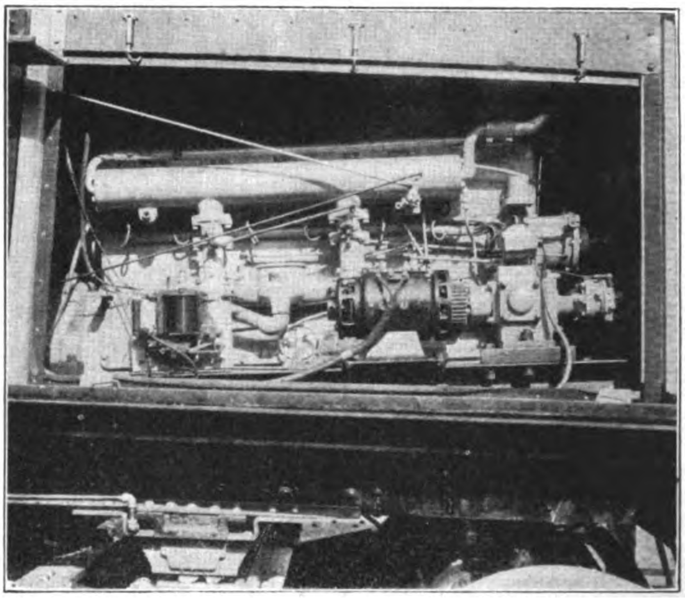
One of the interesting features of the design is an air operated clutch. This development was brought about



Method of mounting the air operated clutch mechanism

by the difficulty of finding a freely operating clutch for mechanically driven cars of large horsepower. A small air cylinder the piston of which is connected to the clutch operating gear so that it assists the foot pressure on the clutch pedal. The first movement of the pedal serves to close the cylinder exhaust valve and open the air admission valve. In releasing the clutch pedal the position of these valves is reversed, and the cylinder pressure exhausted to the atmosphere. The clutch release springs, then function in the usual manner. Another interesting and important feature of design is the use of a subframe suspended by springs from the main frame channels of the motor coach. The transmission units and a two-cylinder air compressor are mounted on this subframe. This method of suspension tends to eliminate gear noises and vibrations from the car body. The entire driving mechanism of the coach may be removed and another unit substituted within two hours time. The power plant itself is mounted in such a manner that it may be removed and replaced within an hour. These features of design are primarily for the purpose of keeping the maintenance cost down to a minimum.

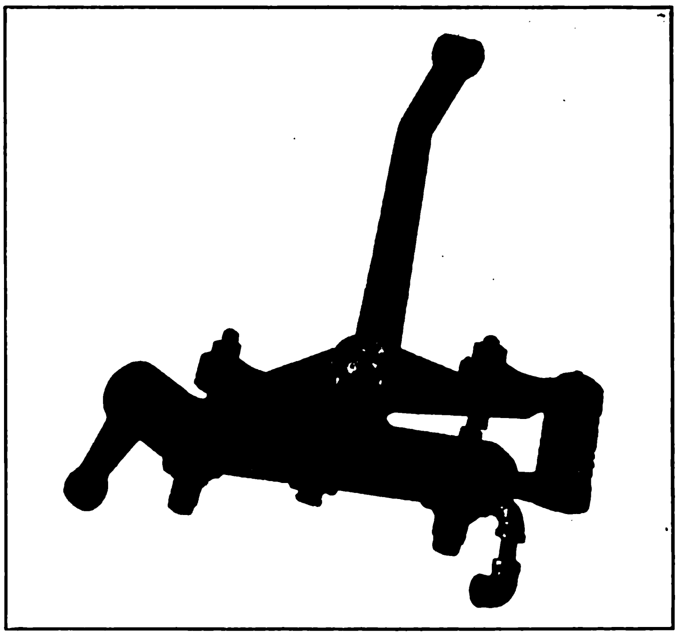
The front and rear trucks are of the standard bolster construction with semi-elliptic leaf springs under the bolster and swinging in a suspended cradle. The wheel



Motor mounted under the hood—the forward bolster is directly under the engine leaving but four feet of overhang

base is 5 ft. 2¼ in. and wheels 30 in. in diameter. The axles are of chrome-nickel steel, heat treated, 3¾ in. in diameter and have 3¾-in. by 7-in. journals fitted with Hyatt roller bearings.

In addition to hand brakes, the cars are equipped with



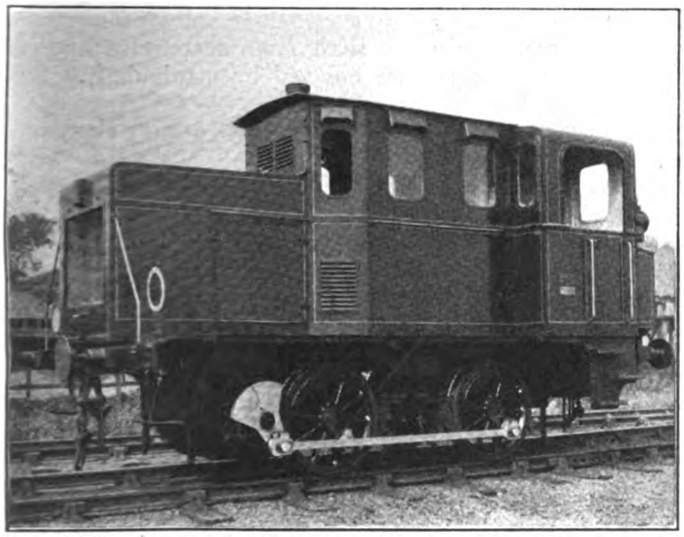
Admission and discharge valves which control the air operated clutch

Westinghouse P. M. and straight air brakes. The air compressor has two cylinders and a capacity of 16 cu. ft. per min. There are two main reservoirs, 16 in. by 48 in. and 10 in. by 24 in. The cars are equipped with A. R. A. automatic couplers at the standard height above the rail.

Hydraulic transmission for Diesel locomotives

Lentz type transmission on switching unit provides three speeds forward and reverse

THE Diesel engine possesses advantages which commend its application to railway locomotives for operation in certain classes of service, such as high thermal efficiency, compact design, cleanliness, ease of operation and particularly the absence of stand-by losses. The internal combustion engine, however, delivers its rated power at a certain speed and it is necessary that some form of transmission be employed which will permit the operation of the engine at a uniform speed while the locomotive works at varying road speeds.



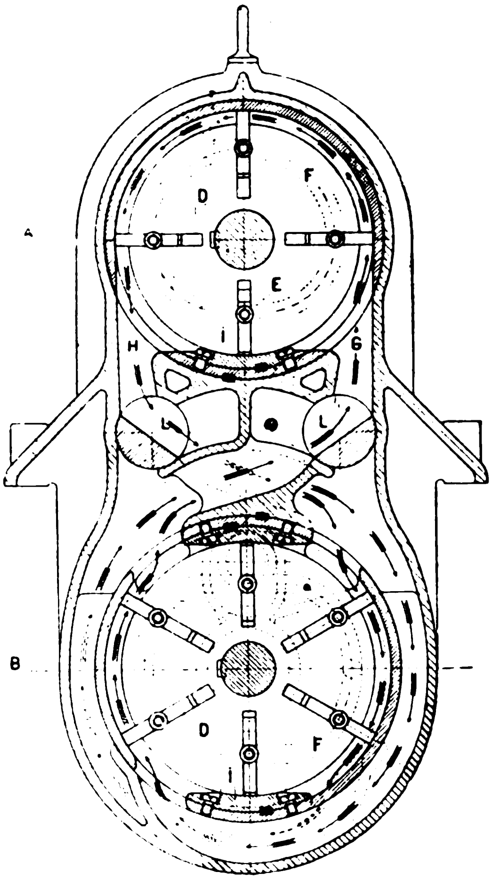
Switching locomotive, with Lentz transmission, driven by a 60-hp. Diesel engine

Of the many forms of mechanical transmission perhaps one of the most interesting is the Lentz hydraulic (oil) transmission which has been incorporated in the design of a switching locomotive, using a Diesel engine, recently tried out in England by the London & North Eastern. The main power plant consists of a six-cylinder, four-cycle, high-speed Diesel engine developing 60 hp. at 350 r.p.m. The hydraulic transmission provides three normal locomotive speeds of 3.1, 6.2 and 9.3 m.p.h.; the corresponding tractive force being 4,000, 2,000 and 1,450 lb., with a potential maximum of 4,850 lb. The total weight of the locomotive in working order is 19 tons.

The axis of the motor crank shaft is longitudinal with the main frames, and this shaft is connected directly with the primary section of the hydraulic gear. The secondary section lies immediately below this, at right angles to it axially, its extremities being fitted with balanced cranks whence the drive is by coupling rods to the driving wheels, the crank throw circle being 19⅝ in. in diameter. The suspension of the driving wheels is by ordinary laminated springs.

The hydraulic gear used on the locomotive illustrated is of a type in which the driving and driven shafts are at right angles but, for the sake of clearly explaining the operating principle of the gear, the sectional drawing shown is of a similar gear having the driving and driven shafts parallel.

The shaft of which A is the center line is that driven by the motor, and has a cylindrical piston rigidly fastened to it. The sides of this piston are closely embraced by walls in the body casting, which also make contact with it below but leave a space above and around for the greater part of its circumference. Within the periphery of this piston are a number of radial slots D, and in these slots are sliding vanes of exact fit which reciprocate in their respective slots and are held by the roller-fitted pins E projecting into the cam-shaped groove F formed in the side walls of the chamber. This groove (or recess) is found upon either side of the rotating piston and is semi-circular above and flattened below the center line, so that the vanes project and make contact with the roof of

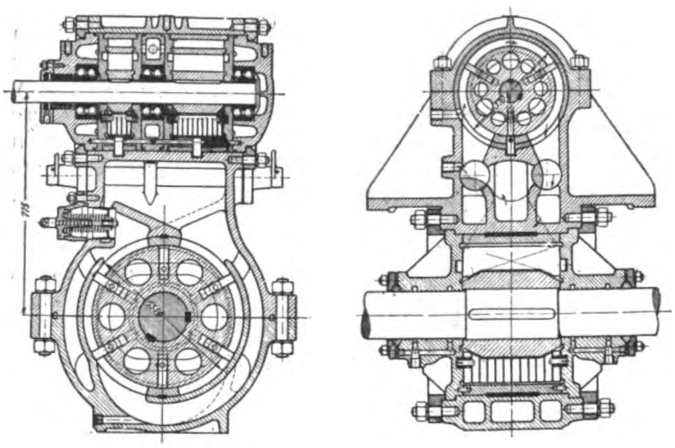


Sectional drawing of Lentz transmission with parallel shafts

the chamber and are withdrawn into the body of the piston at the place where the piston is in contact with the fixed portion of the chamber casting I. It will be seen that the projecting vanes on the rotary piston drive before them the liquid contained between the piston body and the chamber walls towards H in the direction shown by the arrows; simultaneously drawing out the fluid on the

side opposite at *G*. Leakage is avoided by the accurate fit of the vanes, and there are also labyrinth slots (not shown in the drawing) in the surface of the piece *I*, which separates the delivery and suction sides of the containing chamber.

The liquid, which may be almost any kind of clean lubricating oil, flows in the course indicated by the arrows to the lower and opposite side of the chamber where the stream divides, part entering by the upper inlet and the rest through another passage below. There are corresponding vent passages in the casting by means of which the oil escapes and passes back to the suction side of the pump as explained above. The driven rotor or piston is provided with vanes in the same fashion as the driving rotor which are controlled in the same way; but since the pressure is exerted simultaneously upon either side in order to equalize the torque, there are two places where the body of the rotor makes contact with the chamber casting, and consequently the guiding cam grooves have flattened contours in two places, as shown. There is practically no wear on the pump vanes because in the course of their radial movement they are relieved of all pressure, the suction space in the rear of the vane being transformed into a pressure space by the next following vane just before it reaches the end of the pressure stroke. As a result of this, the rollers in their turn have then only the centrifugal force, due to the vane itself, to overcome, and, owing to their lightness, perfect fit and continual immersion in oil, wear from friction may be regarded as negligible.



Lentz gear, with shafts at right angles, such as used on the locomotive described

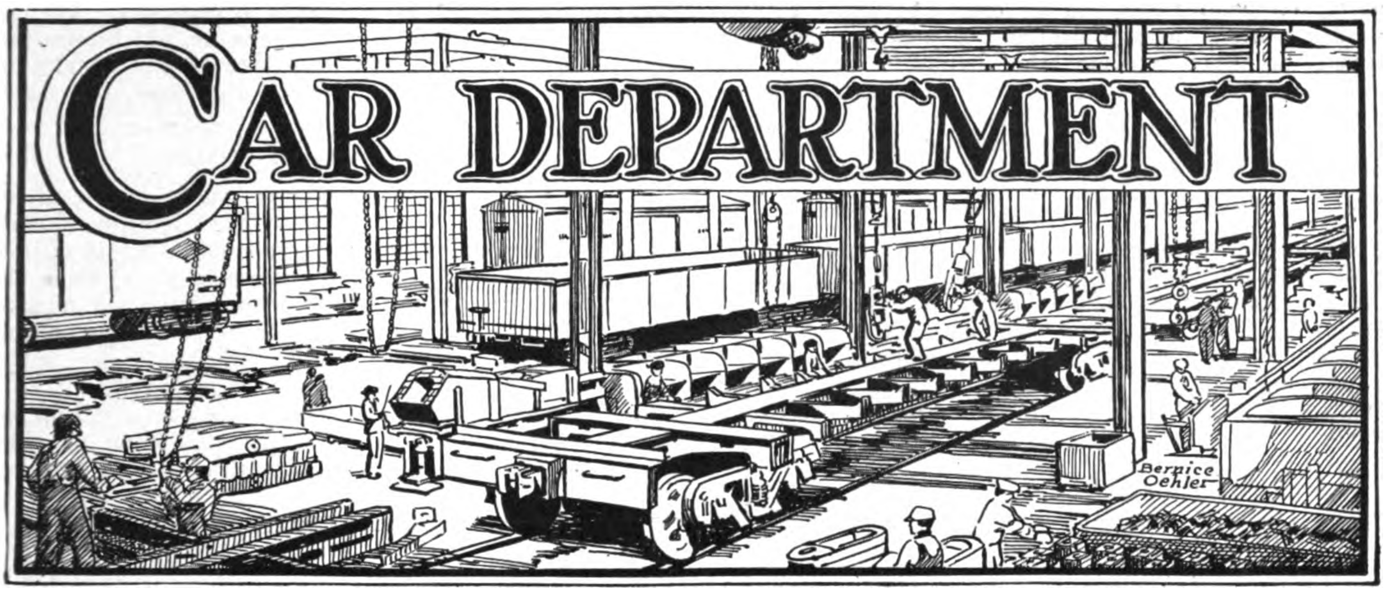
At *L L* are seen two semi-rotary valves, which may be turned to change the direction of the flowing oil stream from one side of the driven piston to the other, and thus alter its direction of rotation.

The foregoing explains the principle by which motion is transferred, from the driving to the driven shaft for either forward or backward running. In order to show how this transmission system acts as a change-speed gear, consider the sectional drawing. It will be seen that the motor driven shaft has two rotors of different widths attached to it, with a separating wall between them. Obviously the smaller piston will drive a lesser quantity of oil before it per revolution than the larger piston, and similarly, by making both pistons work together a still greater quantity is kept in circulation. Meanwhile, the amount of liquid required to displace the driven piston for a given distance is constant, so that by using either the small piston only, the large piston alone, or both large and small pistons in conjunction, three rates of rotation are obtained at the driven shaft from a constant engine speed. These changes are effected by manipulating the rotary valves *L L*.

The disconnection of the driving and driven elements is effected in the simplest fashion by means of a valve built into the center of the casing, which, when closed, divides the pressure chamber of the rotors from the suction chamber of the pumps. It is controlled by a separate lever, and when opened allows the pressure to be neutralized, after which the valves can be moved to any desired position with perfect ease by an arrangement of teeth on the rim of the valve; the pressure is gradually allowed to increase, thus ensuring a perfectly smooth start being effected and no excessive stresses can be generated through careless handling. This valve has the further duty of protecting the transmission by limiting the pressure on the rotor, thus acting as a safety valve, both in forward and reverse directions, and checking any overloads that might develop through too violent a start or a sudden application of the brakes.

The two-piston construction of the driving rotor permits three speeds and reversal. Additional speeds can be obtained by the provision of a third piston, and this is done in some cases, though when more than three speeds are deemed desirable the Lentz system provides a different mechanism than that described.

The shop, office and storehouse of the Boston & Maine at North Billerica, Mass.



Methods of repairing steel cars*

The unit spot system of repairing steel cars is practical and both economical and time saving

By George P. Hoffman

General car foreman, Baltimore & Ohio, Baltimore, Md.

ONE of the most important problems confronting the railroads of this country at present is the repairing and maintenance of steel cars. Each railroad seems to have a different method for making repairs. The greater portion of them are not equipped to properly take care of this important item, and most of this class of work is handled on open repair tracks, without crane facilities. Experience seems to teach that the one method which is completely successful, and efficient for handling this work on open repair tracks is the unit spot system or progressive method.

In order that this system may be carried out, it is necessary to have certain tracks set aside for steel car repairs, and to place the men at different spots on the track, moving the cars down through the tracks, as each operation of the car is completed. This has been developed very successfully by our railroad, organizing the work as shown in the table.

Classification of work and method of designating locations in spot system of car repairs

Color of bulletin board	Symbol	Operation
Red	A	Stripping car for repairs by removing all defective parts that are to be renewed or repaired.
White	B	Repair trucks, underframes, draft gears and attachments.
Blue	C	Fitting and lacing up all parts to place for rivetters, including floors, cross ridge sheets, side hopper, longitudinal hoods, doors, etc.
Green	D	Rivet up parts of car above underframe and apply one coat of paint after quitting time of first shift.
Yellow	E	Apply all safety appliances, hand and adjust doors, repair air brake and hand brake equipment, and applying second coat of paint after quitting time of first shift.
Black	F	Final inspection of cars, tests and adjust brakes, stencil and ship cars.

It is necessary to have all the material to be used at each station, delivered at that point, fabricated, and finished for application, before the men start to work on the cars, so that it will not be necessary for them to move away from their assigned spot for any material. The mechanics who are assigned to the spots perform eight hours' work per day on real mechanic's work, the material being delivered by laborers and helpers, thereby reducing the cost of having mechanics perform work which could be done at a cheaper labor cost.

This system is used in making general repairs, where a car needs renewals of sides and floors, hopper sheets, doors, and other parts of the body. In order that good parts may not be removed and misplaced from cars the work should be checked by a competent car mechanic who should mark up the parts to be removed for replacement, and parts to be removed for repair and replacement. This will insure that the men who are stripping the cars will not destroy a large amount of good usable material.

Rivalry and competitive interests stimulated

It has been found in many places where men are worked under this system, that they will provide themselves with certain shop kinks in order to do their work more efficiently. The men are better satisfied, and will perform a greater amount of work in an eight-hour day than if they were compelled to move their tools from one point to another on repair tracks in order to perform the same operation. A greater efficiency is obtained from the men, for they are continually performing a definite class of work, and become more efficient in its execution each day.

The men at each spot are equipped with the type of tools to perform the particular operation for which they are responsible on each car. This also saves a large amount of tools, as the men on one spot will not require the same tools necessary to perform the operations of other spots.

This system also creates a rivalry among the men who work on the different spots to excel in their work and increase production so that they may lead their fellow-workmen

* From a paper presented at the convention of the International Railway General Foremen's Association, held at Chicago, September 9 to 12, inclusive.

on the competitive spot and the competing unit. In other words, it has a natural tendency to promote competition among the men to produce better results in handling cars through the shop. In order to work the system to the best advantage, of course, it is necessary to have an adequate number of cars passing through each spot daily, which will be gaged by the number of men employed in each unit.

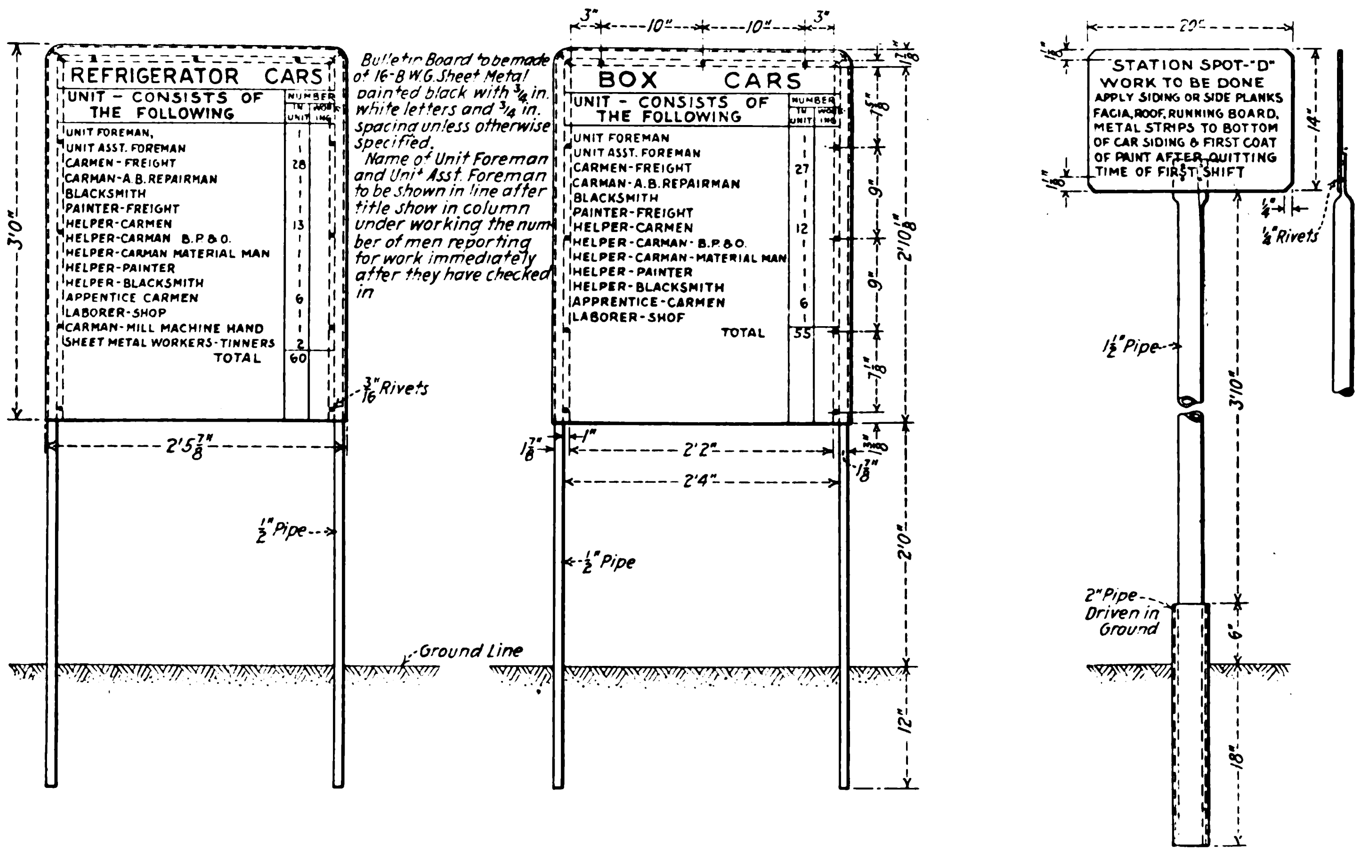
Prompt delivery of material essential

One of the important requirements in carrying out this work is to see that the material is delivered promptly. It has been found that doing this with man power has not produced desired results, and therefore a tractor or an electrically driven truck should be used to deliver the material. They should be kept in continuous operation, to and from material bins and platforms of the various spots. There should be a number of material trailer trucks, to be set off, where the material is to be laid up and the scrap to be small furnaces which are stationery at each spot. The oil is forced through the pipes by air pressure, which saves the cost of handling it through the shops in small tanks or buckets by hand. This will save a great amount of labor and material in any shop.

Dismantling and assembling

Railroads which are equipped with the modern facilities may obtain a greater output and at much less cost if they have the shop supplied with overhead cranes. A shop of this kind should be equipped with a stripping point, where all the deteriorated parts are removed and scrapped, and the material which may be reclaimed, taken to the various presses and straightened out. It is found worthwhile to have sufficient pressure to straighten the steel car parts cold.

After the car has been stripped it should be picked up by the overhead crane and carried to the point where the sills are repaired and riveted up. The trucks should then be



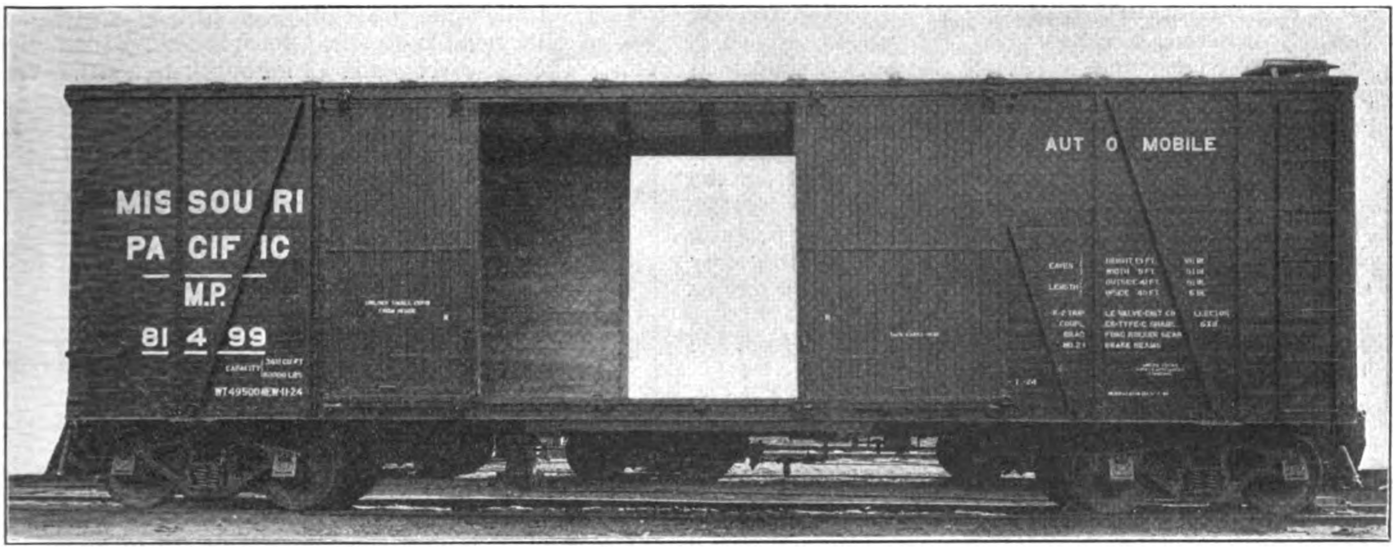
Bulletin boards showing type of cars undergoing repairs placed at ends of the track on which the unit or force is working

hauled away. When loaded, a card is placed in the pocket at the end of the truck, designating to which spot the material is to be delivered. When the operator handling the tractor comes along, he immediately knows by examining the card the destination of the trailer.

The average life of a steel hopper car is estimated at about 15 years, when its superstructure should be rebuilt. This should prolong the life of the car 15 years. It is considered good practice to patch steel cars until the floors and sides have uniformly worn out, after which such parts should be replaced new, and should extend the life of the car about 15 additional years. It should not be considered good practice to allow cars to run which have deteriorated, without substantial patching, which will replenish the lost strength from deterioration. When a car is continued in service in this condition, it is very apt to buckle or collapse, which causes an enormous expense to any railroad in accidents.

On repair tracks where the oil furnace is used, it has been found good practice to pipe the oil from main reservoirs to taken to the last spot, where they should be rebuilt and put in first class condition. The sides of the cars should be fitted and riveted up on a pit riveter and carried to the next spot, and, by overhead crane, delivered to where the sills have been repaired. Then the entire car should be assembled, and carried up to the next spot, where the riveting should be done, then moved up and the trucks placed under the car. It should then be moved to the next spot, where safety appliances should be applied. The car is then ready for painting, and should either be sent to the paint shop or the spot designated for painting.

Another very important item in repairing steel cars is to have the proper material standard to the car applied, and where shops are furnished with this material, they obtain a greater output with less labor cost. The cost of repairs to steel cars will be very high if an attempt is made to manufacture in the shops which have not the facilities for turning out a finished product, to maintain the supply of material to make necessary repairs to cars.

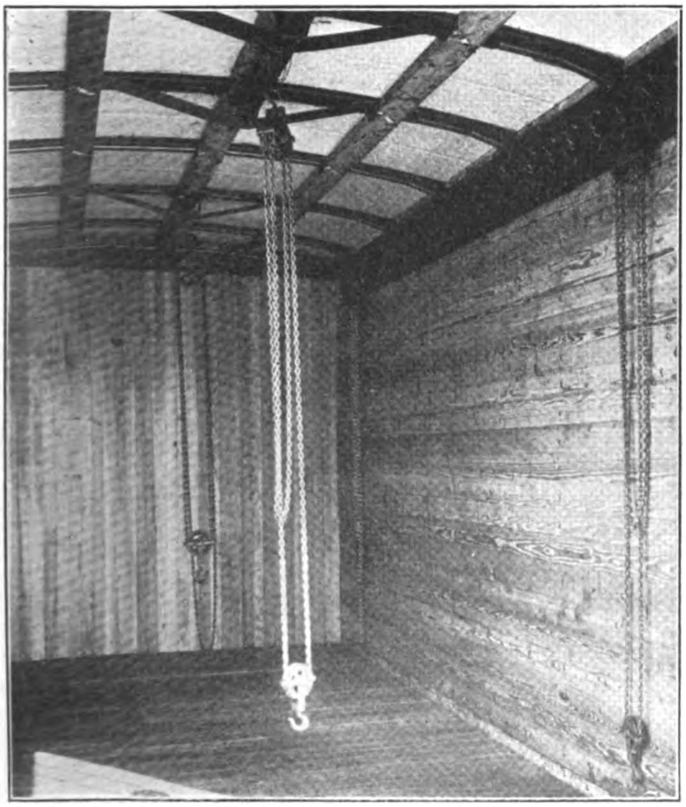


New Missouri Pacific automobile car

Missouri Pacific automobile cars

New design arranged to provide special hoisting facilities—Steel roofs and ends—Large staggered doors

THE steadily increasing movement over the Missouri Pacific of automobiles from eastern and northern factories, and from branch factories and assembling plants at its principal traffic gateways, together with the railroad's policy of providing the most modern equipment for its shippers, resulted in the Missouri Pacific order for 1,000 new 40-ton automobile cars in the latter part of 1924. These cars are now being placed in service. Perhaps their most noteworthy feature is a specially designed hoisting arrangement for loading automobiles within the cars. This arrangement provides both side and center lifting facilities and was devised to meet the most exacting requirements encountered in the shipment of automobiles.



A view of the reinforced T-beam carline sets with hoisting tackle in place at the side and center

The cars are of the steel-frame, single-sheathed type. They are provided with extra thick side sheathing for blocking purposes, staggered doors with 10-ft. clear openings, specially designed Radial all-steel roofs, steel underframes, and Murphy corrugated three-piece steel ends. The cars are 40 ft. 6 in. long, 9 ft. wide and 10 ft. high.

The center hoisting facilities consist of four steel T-beams fastened to reinforced steel carlines of sufficient strength each to carry a load of 2,000 lb. in addition to the roof construction. There are five carlines which are not needed for lifting purposes.

There is one of the T-beam carline combinations on each side of the doorway, with the first of the series set back 3 ft. 1½ in. from the transverse center line of the car. The other two combinations are at each end of the car. To these steel T-beams the automobile manufacturer fastens tongs similar to ice tongs, to which are then attached block and tackle for raising the automobiles.

In addition, there are 36 steel eyes set in the side plate of the car for side lifting. These are arranged in series, four between the first and second T-beam carline combinations nearest the doorway on each side, two between the second and third carlines of these forward sets, and three on each car side between the ends of the car and the innermost hoisting carline.

Such is the arrangement of the hooks and beams that lifting force can be applied with block and tackle from almost every angle or direction and at any place within the car. So far as is known, this method has never been used before.

The extra thickness given to a portion of the side

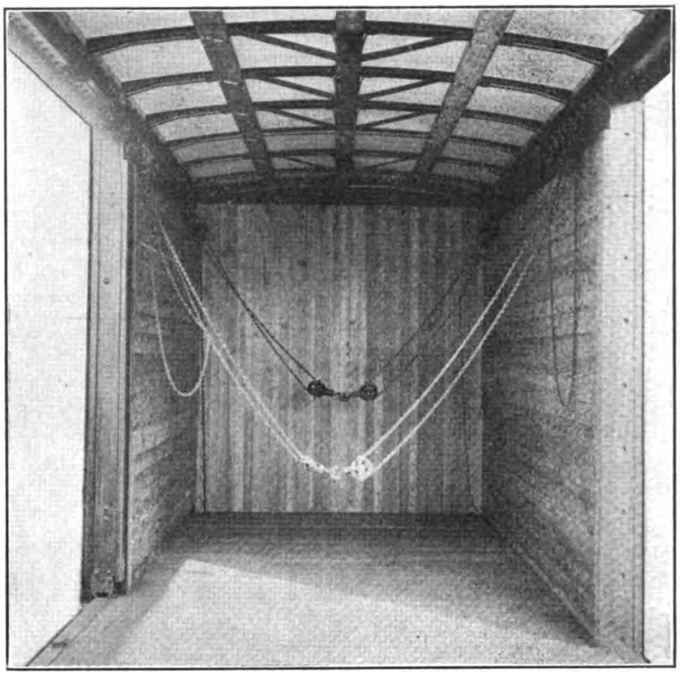
sheathing was devised to provide strong and convenient holding material to which may be nailed, or bolted, blocks for supporting platforms between automobiles loaded on others beneath them. This desired thickness was obtained by applying six tongued and grooved boards, 2 in. thick, with a face of 5¼ in., one above the other, beginning at a height of 3 ft. 3¾ in. from the floor.

The 10-ft. clear door opening, with the stagger feature, is obtained by making the larger side door with a clear opening of 6 ft., or 3 ft. on each side, from the center line of the car, and locating the smaller door, 4 ft. 1⅜ in. wide, on the left side when facing the door from the outside.

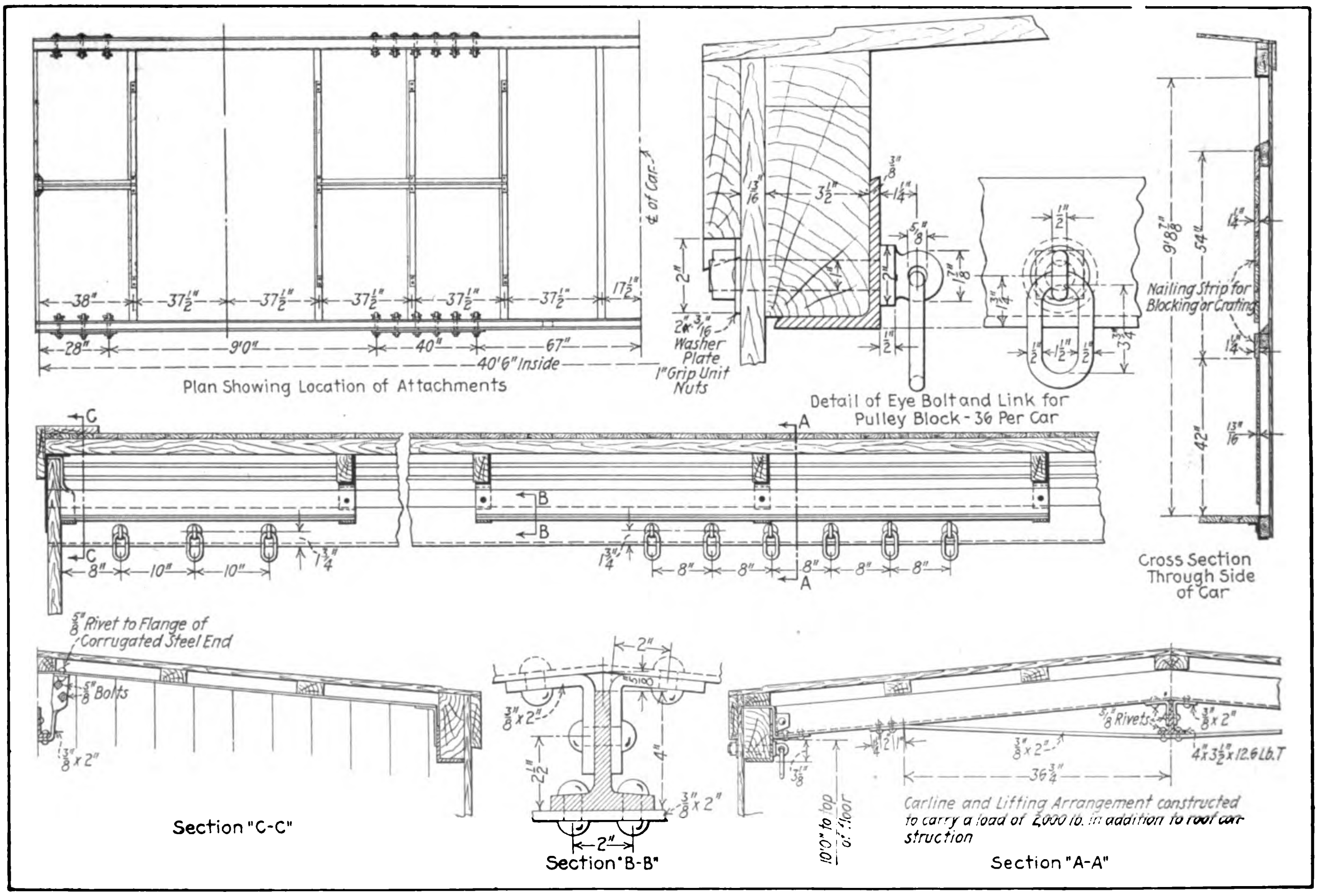
Important construction details

The center sills for these cars consist of two 12-in., 35-lb. channels, spaced 12⅞ in. apart, extending from end sill to end sill with a 20-in. by ⅜-in. top cover plate and a 3½-in. by 3½-in. by ½-in. lower chord angle extending between the bolster filler castings. The specifications call for a cross-sectional area of the center sills of not less than 28 sq. in. The side sills are of Z-bar construction, reinforced at the side doors with a 4-in. by 8.2-lb. Z-bar riveted to the bottom flange and extending 12 in. past the door opening. The body bolster is of box section, having ⅜-in. pressed steel diaphragms flanged 3½ in. all around and placed 11 in. back to back. Top and bottom cover plates extend from side sill to side sill. A diaphragm stiffener of 7/16-in. steel plate is applied at the side bearing.

There are two cross-bearers of 5/16-in. plate flanged 3½-in. all around and reinforced at the top and bottom by 3-in. by 2½-in. by 5/16-in. angles. The cross-bearer center sill fillers are made of ⅜-in. pressed steel flanged 3½ in. all around and extend the full depth of the center sills. The top cover plate, 12 in. by ½ in., extends from side sill to side sill and the bottom cover plate of the same section extends from side to side of the car and is riveted to the side Z-bars.



Tackle in place for side lifting



Arrangement of the lifting attachments in the Missouri Pacific automobile car

A. R. A., Type D, cast steel couplers with 6-in. by 8-in. shanks are used, operation being from the top. The draft gear is of the Bradford rocker type, provided with "G" springs. The cars are equipped with DeRemer-Blatchford side and end ladders and Viloco pressed steel brake steps. The brake equipment consists of Westinghouse Schedule KC-1012 air brakes with double pressure spring type retainers and branch pipe T-bottom outlets. Among the other specialties which are included in the construction are Bettendorf truck side frames with integral boxes and Asco pressed steel lids, Miner rolling rocker side bearings, Chaton fibre dust guards and Schaefer forged three-hole bottom connections and self-locking brake hangers.

Analysis of causes and remedy for hot boxes*

Co-operation in maintenance and the intelligent selection of lubricants are important preventative measures

By M. L. Harger

General foreman, car department, Pittsburgh and Lake Erie, Newell, Pa.

It is well said of those charged with the maintenance of railway rolling stock that there is always a subconscious dread hovering about them of a hot box epidemic breaking loose like a bolt from a clear sky just about the time they think all is going well.

We are all familiar with the usual method of combatting the menace, i.e., tightening up on inspection, whereby more journals are jacked for inspection and more new bearings applied on account of being worn, cracked, or squashed out, so-called conducive elements corrected; more oil is used and more attention given to the treating of the boxes usually resulting in some relief but never completely subduing the hot box, which is conclusive evidence of something basically wrong.

I am in strong accord with the car foreman who stated, "I sincerely believe that with proper and general co-operation in the maintenance of all parts in this connection, that a 50 per cent improvement in results and savings can be made," but after the 50 per cent improvement has been made, you still have some hot boxes. If you follow the same principle to all the "leads" pertaining to the hot box, we should conquer them completely. This is the underlying principle with which I wish to deal in this article.

Eternal vigilance is said by many to be the keynote to successful hot box prevention. By constant vigilance you can keep within certain limits, according to the class of cars and business handled, the full tonnage car being the real trouble, such as those handled in ore, limestone, coal, etc. In such trade where those concerned become a little negligent, it is not uncommon for hot boxes to reach five per cent in the first 100 miles. Careful attention by the inspectors and oilers will bring it down to two per cent, possibly in some cases a little lower.

We often hear the matter referred to as a broad question. It is. But how little the fundamental principle of friction and lubrication is understood by the masses performing the important phases of the different operations to the completed journal under a car. You have only to approach the majority of them, and here again you are back to the foreman who said, "I sincerely believe that with proper and general co-operation in the maintenance of all parts in this connection, that a 50 per cent improvement in results and savings can be made."

After you have corrected all the faults of your yard practice of inspection and treatment which calls for eternal vigilance, you cannot overcome in the transportation yard faulty babbitt, faulty oil, faulty waste, faulty journal turning, etc. These are the underlying faults against which the car repair foreman, his inspectors and oilers, no matter how proficient, are powerless. The average inspector is familiar with the ordinary items usually attributed as being conducive to hot boxes, such as packing that is out of adjustment or glazed, waste grab, dirt, flat wheels, side bearing clearance, broken and compressed truck springs and missing dust guards. After correcting all items known as being conducive to hot boxes, he is at the end of his resources, and his responsibility ceases at this point.

The important items to consider are: the babbitt lining of the bearing, wedge, perfect workmanship and practice in turning journals, good oil and waste.

Reclaimed bearings potential source of trouble

The practice of carrying economy too far in reclaiming journal bearings is the cause of innumerable hot boxes, beyond the control of yard inspection forces.

I will not attempt in this article to draw any conclusions on how far it is safe to go in developing a cheap alloy for lining bearings. Such a paper would be lengthy in itself. The fact is, we have thousands of bearings in circulation, lined with poor alloy which is as detrimental to the service as bad money in circulation. And the greater fault lies with the railroad company that will take an alloy that has caused a hot box, melt it, and reline another bearing with it to cause more trouble, or perhaps melt it with a good alloy and depreciate the value of the whole batch.

The practice of relining journal bearings with so-called babbitt metal reclaimed from all sources without first ascertaining by analysis what it is composed of, is mechanically unsound. It should be analyzed, and where it does not come within set limits, make it so by the addition of the necessary elements to make the standard alloy; then and then only, is the babbitt as good as new.

The practice of having the relining done by men abso-

*A paper submitted in the competition on hot box prevention which closed March 1, 1924.

lutely ignorant of metallurgy, at least within the limits of the metal they are handling, is bad. Such ignorance is the cause of many hot boxes where all other elements were 100 per cent.

While I do not wish at this time to go into details of bearing alloys, I will say I am of the opinion that lining bearings with plain lead and antimony is bad practice, because with little variation of antimony, you obtain a poor alloy. If too little is added, the alloy will become plastic and will readily squash out like dough under a rolling pin. If too much is added, it will crack readily and break away from the shell, and above all, with the slightest failure of the oil, the journal and bearing will abrade each other more readily than other alloys, and when once it grips the journal its destruction is very rapid. This causes a dangerous condition in transit, as such bearings will not respond to temporary treatment intended to carry the car to a terminal, thus necessitating setting the car out at once or taking grave chances on hauling it to a terminal.

Care in selection of oil and waste is important

Proper oil and waste for lubricating journals is of major importance to abolish the hot box, and the same principle applies to oil and waste as to bearing alloy. By far too many accept without question the thought that any kind of alloy termed babbitt is all right or that any form of oil will answer the purpose.

As the use of reclaimed babbitt of unknown content is bad practice, and mechanically unsound, so is the use of reclaimed oil of unknown viscosity, gravity and content.

Many hot boxes are caused by foreign substances in reclaimed oil which will gather along the edge of the bearing until it acts as a "wiper" or works its way into the bearing, forming a carbon coating, absolutely void of any friction absorbing quality, resulting in the gradual heating of the journal. Such heated journals, if caught in time, can be flooded with good oil and if the paste has not formed a hard coating, it is safe to proceed, or the bearing can be cleaned, oiled and replaced. This is the slow developing hot box, very common to the car man, and is the kind of hot box that, if it occurs to a journal in transit having a good babbitt lining on the bearing, can be nursed for quite a long distance by the train crews without much difficulty, and will in time cool down under proper treatment and give no further trouble. The same ignorance usually prevails around the oil reclaiming plant as that associated with reclaiming babbitt and relining bearings, whereby, questionable oil is put in circulation, just as sure of causing trouble as the bad babbitt. The theory of lubrication and the theory of friction and chemical properties of oil is unknown to the average dope reclaiming plant.

The reclaiming of oil is a necessary conservation of the oil supply as well as an economy to the railroads. But in order to make it a real economy, it must be done right.

Oil should not be reclaimed in a back yard plant of every division by inexperienced men, but at a well equipped central point, supervised by a competent chemist, thoroughly versed in petroleum and the friction the oil is to absorb, as well as the conditions under which it must absorb it. Not a drop of oil, new or old, should be used until it has satisfactorily met laboratory requirements.

Such a plant means an initial outlay of money, but it will soon pay for itself and then pay larger dividends in operating savings than any other efficiency movement on the system, assuring a wonderful reduction in hot boxes and lubrication at a surprisingly low figure.

Closely allied with the oil is the waste, which should be handled the same as the oil and completely renovated, preferably at the same central point as the oil. Old waste should never be used until completely renovated and restored to the same specifications as new waste for dope, having the maximum amount of resiliency consistent with the correct proportion of capillary power. Many hot boxes owe their origin to dead waste which lacks enough resiliency to hold the oil in contact with the journal. The inspector or oiler finding a box where the dope lacks resiliency will pack the dope around the journal as solid as possible, but a few jolts of the car and the action of the journal will pack the dope away from the journal for its lubrication until treated at the next terminal, if it happens to run that far without developing a hot box.

Dope should not be prepared at the reclaiming plant for shipment to car shops in barrels or other containers, but properly reclaimed oil and waste should be shipped the same as new oil and waste to the local point and there made up into dope by an experienced man, according to the demands at that point.

Improper wedges increase bearing pressure

The journal wedge is of major importance in the abolishing of hot boxes, because the wedge is an equalizer of the weight to be carried on the journal. The wedge is well taken care of by the use of A. R. A. standard wedge, and where all the provisions surrounding the A. R. A. wedge are right equal distribution of weight is assured. Where they are not, which is quite often the case, the bearing surface is reduced and the weight per square inch increased to a point above 800 lb. which is bound to develop a hot box, because, while some oil will maintain a lubricating film under 1,200 lb. pressure, the average oil will not. Therefore, too much attention cannot be given the bearing surface of the journal box and the wedge, which if worn very much will give undesirable service and become the source of trouble.

The broaching of relined bearings, if mechanically performed, is good practice, especially where the bearing is to be applied to a loaded car of full tonnage, because here you have a condition subjecting the lubricant to its utmost, where it must lubricate under pressure exceeding in most cases 800 lb. per sq. in., and where the bearing has been broached it has a good smooth surface and increased bearing surface for a start. Seventy-five per cent better service is recorded as the result of broached bearings under loaded cars, which is conclusive evidence aside from the theoretical argument. The broaching of second-hand bearings causes many hot boxes due to proper inspection not being made, whereby cracked lining and otherwise defective alloy is put in service.

Poor journal turning a contributing factor

Not the least of hot box trouble can be traced to faulty journal turning, and is a matter which must be watched with as much diligence as yard and shop practices. The practice of taking a rough cut from a journal and rolling it does not, at its best, give a 100 per cent job, and where care is not taken to make the best possible cut a satisfactory result in operation will not be obtained. The tool should never be adjusted in the middle of the cut, and if exceptional care is not taken with the roller, the journal will have a series of waves; the bearing will bear only on the crest of the waves, causing increased pressure, or the bearing will seat in the waves and the lining be destroyed by the lateral motion.

I believe that the day is not far off when the A. R. A. will incorporate into the rules for billing foreign car owners, such provisions as will assure the application of bearings lined with a babbitt metal of known good content, oil of known viscosity and gravity, free of all foreign substance, and good clean, live waste of proper resiliency and capillary power, in order to justify billing.

In closing, there is one reliable method of combating the hot box, and many of the other difficulties in railroad operation. That is knowledge—knowledge of existing facts at the time of their existence, not a month or more later.

This of course is recognized by many of our railroads and practiced to some extent by many, but in most cases in a disorganized haphazard fashion. On many roads the old-fashioned theory of keeping everybody in ignorance is still in vogue. Nothing can be gained by, or is more harmful than, dissimilation of conditions. Meet any condition full in the face, meet a fact with a fact, conquer or be conquered. Armed with the mechanical theory, full knowledge of all existing facts, you can overcome an epidemic of any kind.

In order for a foreman to have these weapons he must chart his operations, know at a glance when they are good, and be able to see at a glance the first indication of something going wrong; immediate investigation will correct the matter before an epidemic starts. The foreman cannot keep his chart up to the minute without the co-operation of the divisional officer over him, who should keep him well supplied with the information he cannot gather locally. On the hot box question he should be furnished promptly with the initial and number of every car having journal failure leaving his point, together with inspection pass marks, and the opinion of the foreman under whose jurisdiction the repairs were made.

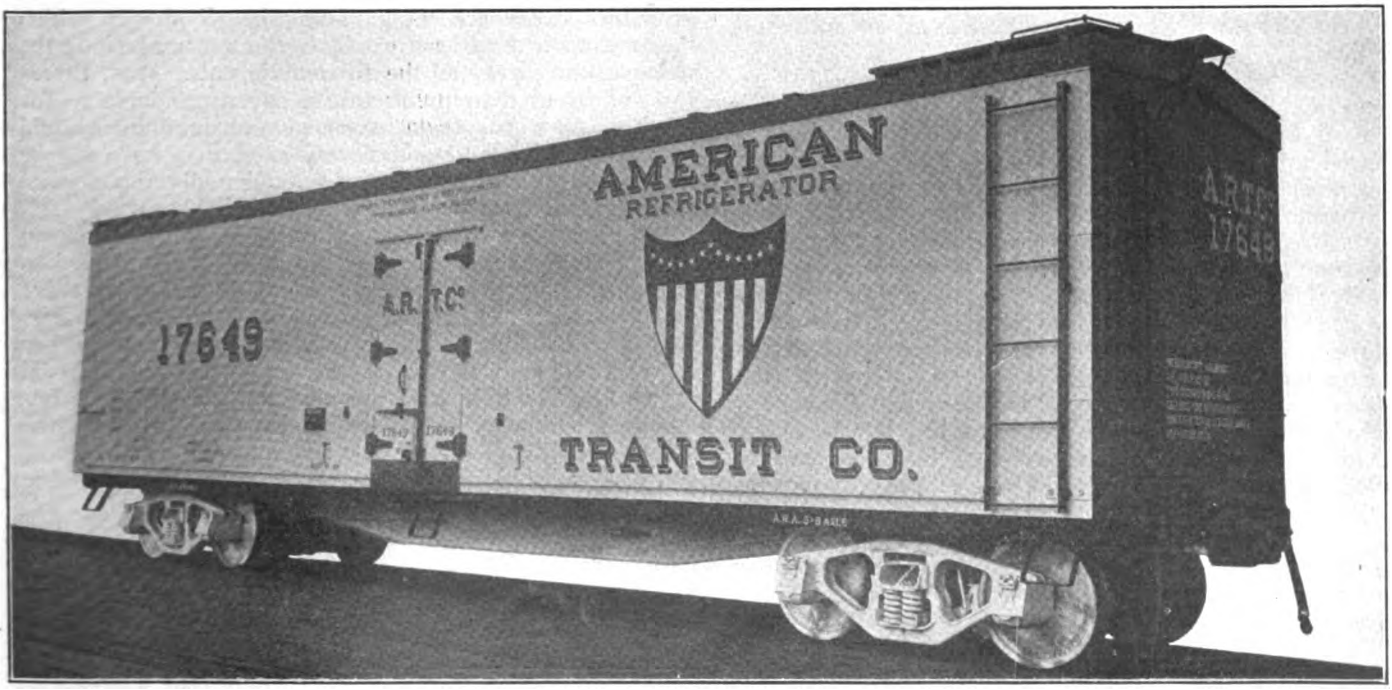
Every department should have its intelligence department, which should gather all facts, analyze all failures, have experts to cover certain fields of operation, to school the inexperienced and correct the faults, furnish the foreman promptly with information pertaining to failures in certain lines; just as the laboratory is essential to the manufacturer of steel, so is the intelligence department essential for successful operation of the railroads. Without the laboratory and chemist, the steel manufacturer would be ruined by the bad steel manufactured before he corrected the fault. Without the intelligence departments the railroads will have epidemics and failures of various kinds which they will not understand. Take your choice.

American Refrigerator Transit buys new equipment

Modern features of design are incorporated in large order of new refrigerator cars

LAST September, the American Refrigerator Transit Company, a private refrigerator car line owned jointly by the Missouri Pacific and the Wabash, divided an order for 2,000 refrigerator cars among the American Car & Foundry Company, the Mt. Vernon Car Manufacturing Company and the General American Car Company and the work of constructing these cars is now practically completed. They embody the most serviceable features developed over a long period of years.

The cars, built with steel underframes, are 39 ft. 9 in. long; weigh 58,000 lb., and have a capacity of 80,000 lb. They are equipped with the basket type ice bunkers having a capacity of 10,500 lb., and insulated bulkheads. These ice baskets are made of heavy galvanized wire



The new A. R. T. refrigerator car

netting and are suspended in the bunkers in such a way as to allow about two inches of space between the netting and the walls of the car on all four sides. This gives a free circulation of the air, allowing it to come in contact with the ice on all four sides and causing much more rapid refrigeration than could be obtained otherwise. The insulated bulkheads result in a better circulation of cold air through the car. Each bulkhead is insulated so as to allow no infiltration of air except at the top and bottom, there being an opening of about 12 in. at both places. The warm air entering at the top of the bunker comes in contact with the ice and passes out at the bottom opening. On account of the limited open space at the bottom of the bunker, the cold air of its own pressure is carried all the way to the center of the car, circulating freely under the floor racks and touching all parts of the load.

The floor racks in question are hinged to the side walls so that they may be raised to permit a thorough cleaning of the car floor. The use of these floor racks gives a more thorough circulation of the cold air under the load as well as a protection from excessively low temperatures by keeping the commodity off the floor proper. They also allow the warm air, where cars are moving in heater service, to circulate under the load.

The cars are equipped with No. 22 gage metal roofs of the Murphy X L A type. The underframe is of the fish-belly type and the trucks have cast steel side frames and cast steel bolsters. The roof insulation consists of 2½ in. of Hairinsul, the floors 2 in. of Hairinsul in addition to the double flooring, and the air space and the side and end walls consist of 1½ in. of Hairinsul and two layers of Celotex, each being ½ in. thick.

Special attention given to insulation

Between the stringers is placed a false floor on which is laid two inches of insulation. A ⅞-in. tongue and grooved floor is laid on the stringers and over this is spread a layer of waterproofing asphalt, the regular 1¾-in. flooring being placed on top. Waterproofing material is also poured between the framing on the sides and ends to prevent water seeping through. This waterproofing material meets a rigid specification so that it will stand up under extreme heat or cold. In addition to waterproofing the floor, the insulation in the walls is covered with a layer of waterproofing paper in order that it may be kept dry and retain its efficiency as an insulating medium.

Celotex, which is comparatively new in the field of refrigerator car insulation, is made from the pulp of sugar cane, thoroughly ground and the fibres interlaced and pressed into boards ½ in. thick and of any desired size. It is much lighter than lumber and its insulating value is approximately three times as great. In these cars, Celotex has replaced the sheathing, both inside and outside of the framing, reducing the weight of the car approximately 4,000 lb. Celotex also adds to the rigidity of the car body because it is applied in large sections the full height of the car, so that its diagonal strength is much greater than that of lumber.

Ten of these cars are being insulated with Dry Zero, a product of the Johns-Manville Company, which is comparatively new in the refrigerator car field. This material has already been applied in a few cases but the application in these cars is different from any previously made. In the past, it has been applied entirely in bulk, packed between the framing, but in this lot of cars it is applied in blanket form in the side and end walls. A blanket of the material two inches in thickness and sewed between layers of burlap is applied on the outside of the framing between the sheathing and car siding. In the roof and floor, four inches of Dry Zero is compressed approximately 40 per cent, being packed between the floors and between ceiling and roof.

Fifty of the new American Refrigerator Transit cars will be equipped for passenger train service and will be known as express refrigerator cars. They will be 50 ft. in length, equipped with heating and lighting systems, metal bulkheads, etc. The other cars will be placed in regular refrigerator car service.

Economies effected by insulating train steam pipes*

By William N. Allman

General Railroad Department, Johns-Manville, Inc., New York

ECONOMY in operation and conservation of fuel has been the subject of considerable discussion during the past few years in locomotive operation and at the present time it is a matter of paramount importance. The conservation of fuel should, therefore, receive careful attention and investigation. There has not been much data presented on the subject insofar as train steam pipes are concerned, and in a large number of cases the railroads have treated this most important subject lightly. In the operation of passenger train equipment there is considerable exposure in the train line; for a ten-car train there would be approximately 500 sq. ft. of exposed surface. If this surface is not adequately insulated there would be a large loss of heat units.

In meeting the necessity for effectively insulating these pipes against loss of heat, the question arises as to the proper material that shall be used, and what is of even greater importance is the thickness of material that shall be employed to secure the greatest economy. There are a great many types of commercial pipe covering on the market at the present time and it is, therefore, necessary to select wisely the proper insulation in order to obtain the results desired. These types may be generally classified under three headings, namely, the laminated, moulded and cellular type.

It should be borne in mind that the efficiency of all insulators varies according to the size of pipe to which they are applied, and according to the temperature of the steam in the pipes and the surrounding air. It is, therefore, apparent that in selecting a covering adaptable for this service, construction, efficiency and durability should be considered. It should be observed that it would be subjected to continuous vibration and under this service every type of covering would not be suitable.

Efficiency is a very important factor, for the reason that the lines which are to be insulated are subjected to extreme changes of temperature and, furthermore, there is a great increase in loss of heat due to the air velocity on the pipes. The efficiency of pipe covering is the per cent saved by insulating a pipe with a certain material of what would be lost if the pipe were left bare or uninsulated. This per cent is obtained by subtracting the heat loss of the insulated pipe from that of the bare pipe and dividing the difference by the heat loss from the bare pipe. Expressed as a formula it would be as follows:

$$E = \frac{A - B}{A}$$

where:
E = Efficiency
A = Heat loss through bare pipe
B = Heat loss through insulated pipe

*Paper presented before the Manhattan Air Brake Club, New York, on December 18, 1924.

The heat losses may therefore be compared directly as follows:

Bare pipes ....100 per cent
Efficiency ....per cent saving
100 per cent — per cent efficiency = loss through insulation expressed as a percentage of bare pipes.

For example, an insulation having an efficiency of 86 per cent allows a loss of only 14 per cent of the loss from bare pipes.

As an example of the increase in heat losses from bare and insulated pipes due to wind velocity, the following will show approximately what is encountered:

Wind velocity, miles per hr.	Percentage of heat loss for bare pipe in still air	Percentage of heat loss for insulation 1 in. thick
5	155	21.0
10	260	26.0
15	335	28.2
20	397	29.6
25	450	30.6
30	493	31.2
40	562	32.1
50	610	32.7
60	648	32.9

The above table indicates what effect velocity will have on losses and, on bare pipes, it will be noted this mounts up very rapidly. The table as prepared is for a very high-grade of pipe covering. For other materials the losses would be greater in about the same proportion that their rated losses are greater. These values are necessarily only approximate but give an idea of what these particular losses amount to.

Three types of insulation discussed

Not all pipe coverings can be termed good insulation, some being efficient at low pressures, but very inefficient at higher pressures. Some coverings are fairly efficient when first applied but soon deteriorate and do not maintain their efficiency, while others maintain their initial efficiency indefinitely. The underlying principle of efficient insulation is confined to dead air cells, and perhaps one of the best forms of pipe covering is that of the laminated type, which consists of a number of layers of felt composed of asbestos fiber and particles of finely ground spongy material, this combination forming an extremely cellular felt. These layers of felt, being built up in laminated form, confine a large volume of minute dead air cells between the layers, and the general construction makes it a highly efficient covering and one that is most durable as well as maintaining its efficiency indefinitely.

Speaking in general terms of insulation, the next best form, perhaps, is the moulded type of insulation, which is a light, highly efficient insulation. In this type of covering there is also a large number of microscopically small dead air cells. These cells cause the air to become stagnant, and thus a very poor conductor, thereby increasing the efficiency. This particuar form of pipe covering, however, is not as adaptable to service on train pipes as is the laminated form, because of the constant vibration already referred to soon has a tendency to disintegrate the covering.

The next best classification would be that of the cellular type. In order to give an approximate idea of the saving which would be obtained from the various types of pipe insulation on a comparative basis on covering of a known efficiency, I will designate for the sake of convenience three types, known as A, B and C, all 1 in. thick.

A—Laminated form.
B—Cellular type, corrugations running around the pipe, not parallel with pipe.
C—Layer form with indentations in layers.

The efficiency of these coverings for a 2-in. pipe and for the temperature difference dealt with hereafter, are as follows:

A—85.84 per cent.
B—82.00 per cent.
C—78.60 per cent.

For our investigation we will consider a 10-car train, each car having 80 ft. of 2-in. pipe, which is equivalent to 500 sq. ft. of radiating surface. Train line pressure 50 lb., outside temperature 20 deg. F. above zero. The calculated results would run as follows:

Loss in B.t.u. per hour, per sq. ft. bare pipe	1,070
Total radiating surface, sq. ft.	500
Total loss in B.t.u. per hour	535,000
Hours of service per day	16
Total loss in B.t.u. per day	8,560,000
Temperature of steam in train line at 50-lb. pressure	334.3 deg.
Outside temperature	20.0 deg.
Temperature difference	314.3 deg.

Assuming coal to have a thermal content of 10,000 B.t.u. which is very conservative, this would be equivalent to 856 lb. of coal per day loss, or at $4 per ton we would have $1.71 loss per day from bare pipes.

The saving per day effected by using the three types of covering which have been described would be as follows:

Type of covering	Efficiency	Saving per day
A	85.84 per cent	$1.47
B	82.00 per cent	1.40
C	78.60 per cent	1.35

The initial cost of the covering would soon pay for itself and the saving of wasted heat units and ultimate dollars and cents would soon amount to a considerable item. The temperature of steam in a train line of 334.3 deg. F., as covered in the above analysis, is obtained from the following formula:

Temperature of steam (saturated) at boiler pressure of 200 lb. per sq. in.	338 deg. F.
Total heat in saturated steam at 200 lb. per sq. in.	1,199.2 B.t.u.
Total heat in saturated steam at 50 lb. per sq. in.	1,178.5 B.t.u.
Difference	20.7 B.t.u.

Since the change through the reducing valve has been a constant heat change, that is, no work done and no heat gained or lost, the heat in steam at 50 lb. per sq. in. above normal saturation content must be in the form of superheat. Therefore:

$$H_t = S\,(T_s - T_n)$$

Where:

H_t—Total heat above saturation heat content
S—Specific heat of superheated steam
T_s—Highest temperature of superheat
T_n—Normal temperature of steam at pressure given

Therefore:

$$H_t = 20.7 \qquad S = .57$$

Substituting:

$$20.7 = .57\ (T_s - T_n)$$

$$\text{or } (T_s - T_n) = \frac{20.7}{.57} = 36.3$$

$$T_n = 298.0$$

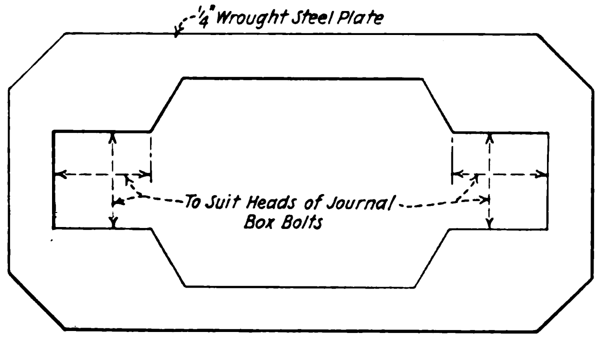
$$\text{or } T_s = 298.0 + 36.3 = 334.3$$

The above conditions and analysis may be considered normal, and results would vary with temperature conditions. For example, in certain sections of the country during the winter the temperature would be much lower than that considered above, also, as the velocity of train increases the loss is greater and as the foregoing is based entirely on still air conditions, the saving would be even greater and more so by using the best insulation, or that having the highest efficiency.

A handy device for the truck repair man

A SIMPLE device for holding the heads of journal box bolts while removing or tightening the nuts, is shown in the sketch. It is made from ¼-in. steel plate. The outside edge and center opening can be readily formed with a cutting torch. The holes for the bolt heads should be

cut square and provide a reasonably close fit to hold the bolt securely. The car repair man places the plate on the top arch bar so that the heads of the journal box bolts fit



A device which eliminates an extra wrench and holds both journal box bolts while the nuts are being removed

into the slots. The nuts can then be applied or removed without any liability of the bolts turning.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Second application of journal bearings on different roads comprising the same system

On December 15, 1922, the Oregon Short Line applied a journal bearing to C. B. & Q. car No. 132,798 at journal box location L-4. The charge was reported on the billing repair card which was included in the audit bill of the car owners. On December 25, 1922, the Union Pacific applied a journal bearing to the same car at the same journal box location and the charge made on the billing repair card was included in the audit bill to the C. B. & Q.

On December 9, 1922, the Oregon-Washington Railroad & Navigation Company applied a journal bearing to C. B. & Q. car No. 98,944 and included the cost of repairs in their audit bill using a Union Pacific billing repair card. On December 12, 1922, the Oregon Short Line applied a journal bearing to the same car at the same journal box location and the charge was reported on the billing repair card which was included in the audit bill. The charge for a prior application on the Oregon Short Line, November 22, 1922, to the same car, same journal box location, was included in their audit bill on a Union Pacific billing repair card.

Claims presented by the C. B. & Q. to the Union Pacific for cancellation of one or more of the charges was declined by the Union Pacific on the grounds that such applications of journal bearings were made by separate railroad companies, and, therefore, Rule 99 did not apply to these cases. Insofar as Interchange Rules are concerned, the Union Pacific is comprised of four subsidiary companies which should be considered as individual railroads.

It was contended by the Union Pacific that the four subsidiary lines commonly known collectively as the Union Pacific System are separate units, under the laws of the United States, and therefore, also under the Interchange Rules of the A.R.A. The Union Pacific substantiated this statement by giving eight reasons why the four units should be considered as separate railroads.

The C. B. & Q. contended that so far as Rule 99 was concerned, the several units of the Union Pacific System should be considered as comprising one and the same road and not as individual foreign roads. Therefore, when a foreign car has a journal bearing applied and charged for on two or more of the units of the Union Pacific, such charges should be subject to the provisions set forth in the rules.

The Arbitration Committee in rendering a decision in this case, stated that: "In view of the status of the four roads in question with regard to their relation to the Union Pacific System as explained by the Union Pacific, they are properly considered as separate roads in application of Rule 99. Therefore, the contention of the C. B. & Q. is not sustained."—*Case No. 1319, Union Pacific vs. C. B. & Q.*

Responsibility for damaged car offered in interchange

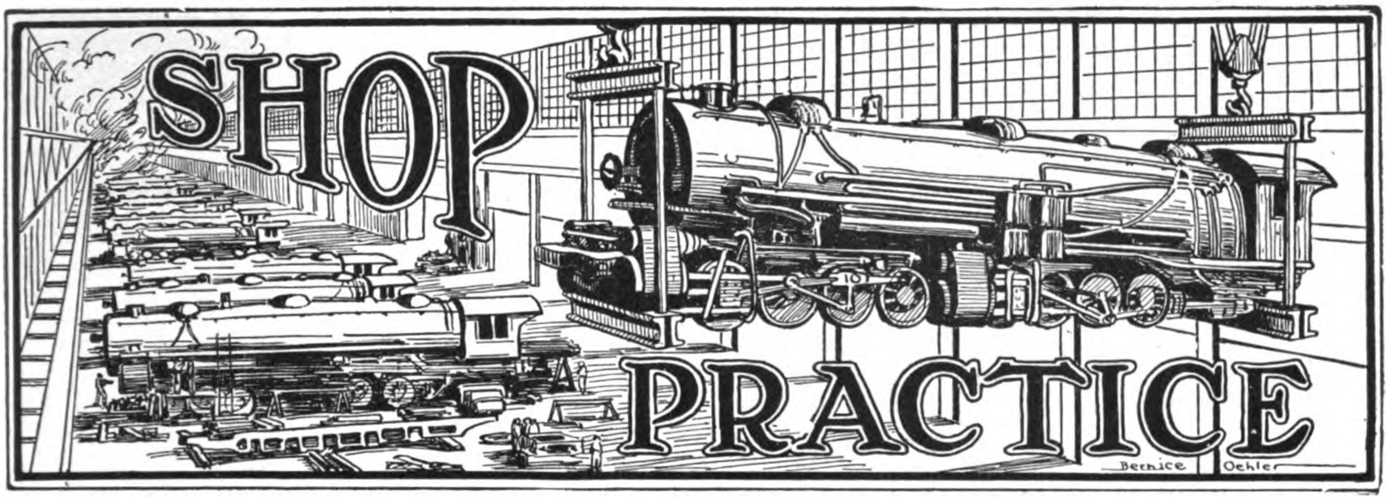
Pierce Oil Corporation tank car No. 2393 was wrecked in derailment at Randolph, S. D., and damaged to such an extent that it was necessary to load it on a flat car for movement to the Minneapolis shops of the Minneapolis & St. Louis for repairs, and on March 22, 1922, the owners were advised of its release for service. The car was moved home to Sand Springs, Okla., via Minneapolis & St. Louis to Wabash at Albia, to M.-K.-T. at Kansas City, to Sand Springs Railway at Home Junction for delivery to the owner. On April 11, the day after delivery, a joint inspection was made, on the basis of which the car owner contended that a number of defects had been left unrepaired and that in some cases wrong material had been applied. The Minneapolis & St. Louis stated that there may have been a possibility of other roads which handled the car from the time it left its Minneapolis shops until delivery to the owner contributing to damage en route. It also stated that defect cards for wrong repairs as claimed had been furnished, but refused to furnish cards for the other items, being of the opinion that it was not responsible, in view of the fact that the tank was put in good condition before leaving the shops and had passed inspection points without exceptions.

The Arbitration Committee, in a decision rendered February 15, 1924, decided that, with the evidence presented, the car owner's recourse is against the delivering line in accordance with the first paragraphs of Rules 2 and 4.—*Case No. 1318, Pierce Oil Corporation vs. Minneapolis & St. Louis.*

Responsibility for car damaged in switching

The Michigan Central humped a cut of six cars in the Niles, Michigan yards, February 15, 1923, damaging Midland Valley box car No. 4047 to the estimated extent of $1,000. The Michigan Central claimed that the car was not derailed, cornered, side swiped or otherwise damaged as outlined in Rule 32, but on the other hand failed in ordinary handling owing to the general worn out condition. The car owner claimed that the damage to this car was due to the causes set forth in paragraph *D* of Rule 32 and was the handling line's responsibility.

The Arbitration Committee rendered the following decision: "The car was not subjected to any unfair conditions and, according to Rule 32, the car owner is responsible."—*Case No. 1321, Midland Valley vs. Michigan Central.*



British methods of setting locomotive valves

By F. Norman
London, England

THE operation of setting locomotive valves is one in which the need for accuracy will be self-evident to those interested in this subject. The purpose of this article is to describe the practice of setting valves, adopted by a large locomotive works in England. The fact must first be appreciated that any divergence of lead of the valve, relative to the cylinder ports, from that laid down by the designer, may result in a measure of inefficient working, due to losses of steam, etc.

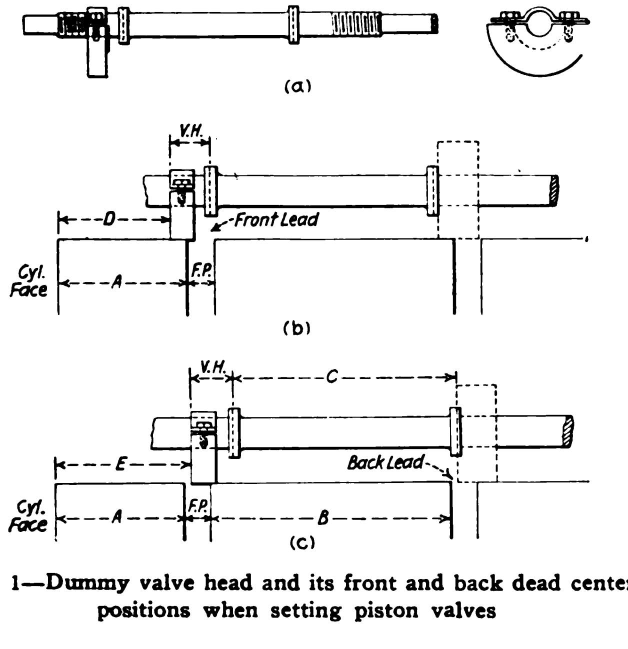


Fig. 1—Dummy valve head and its front and back dead center positions when setting piston valves

Method of setting piston valves with internal admission

The responsibility of setting the valves on all locomotives is in the hands of a mechanic known as the valve setter. He performs his duties at any stage of the erection of the locomotive as most convenient to the progress of the work through the shops. His first step, after the cylinders have been erected with the valve liners pressed in, consists of measuring, by means of a vernier, the position of the ports relative to the front face of the cylinder. These dimensions form the basis of all the valve setting calculations, both when the locomotive is first erected and at any later time when it may be returned to the shops for repairs. A permanent record is kept of these figures for each locomotive. It is well to state that these dimensions almost invariably differ, owing to slight inaccuracies in machining, from those laid down by the designer.

It will be appreciated that, with piston valves a much closer setting is possible than is the case with slide valves for the reason that each valve head is independent of the other and can be adjusted to govern the admission of steam at its respective end of the cylinder. A dummy valve head as shown at *A* in Fig. 1 is used when setting the valves. This is mounted on the valve spindle, the collars of which are left ¼-in. wider than required to allow for the necessary adjustments. Another method adopted in some works is to make the collars according to the dimensions called for by the drawings and then use thin steel washers between the heads and the collars. The objection to this practice is the possibility of the washers either being lost or wrongly assembled, when the locomotive is overhauled, which will alter the leads.

The dummy head is made 1 in. shorter than the valve head. It is placed on the valve spindle, inserted in the cylinder, and the whole coupled up to the valve motion. The engine is placed on the front dead center and then the head is adjusted to its correct position relative to the front cylinder face. Following this, the spindle is removed from the cylinder and put between lathe centers. The collar is then faced up so that a 1-in. setting block will pass between the collar and the dummy head. This will insure that the valve head will be in its correct position when assembled on the valve spindle.

Sketch *B*, Fig. 1, shows the position the valve spindle

and the dummy head should occupy when the engine is on the front dead center. Referring again to sketch *B*, it will be seen that:

$D = A + FP - (FL + \text{standard valve head})$ when,
D = distance of dummy head from front of cylinder.

Take for an example the measurements on a locomotive which show that:

$A = 7.998$ in.; $FP = 1.747$ in.; $FL = .125$ in.; $WH = 2.5$ in.
$D = 7.998 + 1.747 - (.125 + 2.5)$
$D = 7.120$ in.

When the locomotive is on the back dead center:
$E = A + FP + B + BL - (C + VH)$

Assuming for the moment that the dummy head has been adjusted with the engine on the front dead center to bring the valve head to its desired position, then since the distance *B* between the two ports is fixed, it follows that *C* must also vary in proportion. For example, if *B* is found, after measuring, to be .005 in. wider than as designed, the dimension of *C* should be increased a like amount, for otherwise, the back lead will be increased or decreased accordingly. Thus on the same engine where:

$B = 10.505$ in. as against the designed 10.500
$BL = .250$ in.
$C = 14$ in. according to design
$E = 7.998 + 1.747 + 15.505 + .250 - (14.005 + 2.500)$
$E = 8.995$ in.

It may probably be found by the valve setter that after having adjusted his dummy head with the engine on the front dead center, when he places his engine on the rear dead center and takes his measurement, a discrepancy will be found between the actual and the calculated figures. It is then his object to minimize this difference by dividing the distance between the two centers. Emphasis is laid on the fact that when the front collar on the valve spindle is faced up, the back collar must also be machined to give the correct distance between the two heads. This automatically ensures that the back lead shall be correct.

Table for Setting Valves - Class Y Engines with Walschaert Valves

Standard Dimensions A-8", B-15.5", C-14", FH-2.5", F.P.-1.750, F.L.-.125, B.L.-.250

	Front Port													
	1.747		1.748		1.749		1.750		1.751		1.752		1.753	
A	D	E	D	E	D	E	D	E	D	E	D	E	D	E
7.997	7.119	8.994	7.120	8.995	7.121	8.996	7.122	8.997	7.123	8.998	7.124	8.999	7.125	9.000
7.998	7.120	8.995	7.121	8.996	7.122	8.997	7.123	8.998	7.124	8.999	7.125	9.000	7.126	9.001
7.999	7.121	8.996	7.122	8.997	7.123	8.998	7.124	8.999	7.125	9.000	7.126	9.001	7.127	9.002
8.000	7.122	8.997	7.123	8.998	7.124	8.999	7.125	9.000	7.126	9.001	7.127	9.002	7.128	9.003
8.001	7.123	8.998	7.124	8.999	7.125	9.000	7.126	9.001	7.127	9.002	7.128	9.003	7.129	9.004
8.002	7.124	8.999	7.125	9.000	7.126	9.001	7.127	9.002	7.128	9.003	7.129	9.004	7.130	9.005
8.003	7.125	9.000	7.126	9.001	7.127	9.002	7.128	9.003	7.129	9.004	7.130	9.005	7.131	9.006

Fig. 2—Table for setting valves on a locomotive equipped with the Walscheart gear

To eliminate the necessity of making a calculation for each locomotive, a table, as shown in Fig. 2, was compiled, giving at a glance *D* and *E* for all probable variations of *A* and the front port measurements.

Setting the D-type valve

When setting the flat D-type valve a somewhat different procedure is followed. In this case the admission of steam into both ends of the cylinder is controlled by one valve. Sketch *A*, Fig. 3, shows the position on the front and back dead centers respectively. From sketch *A* it will be seen that the distance of the valve from the front cylinder face $= A + FL$. In a similar manner

$D = A + B - (BL + \text{total width of valve})$.

As an example, on a certain engine the dimensions for one cylinder were:

$A = 13$.; $B = 8\frac{3}{4}$ in.; $FL = \frac{1}{4}$ in.; $BL = \frac{1}{8}$ in.
Total width of valve $= 10\frac{3}{4}$ in.
Therefore:
$D = A + FL = 13 + \frac{1}{4} = 13.250$ in.
And also:
$D = A + B - (BL + \text{width of valve})$
$D = 13 + 8\frac{3}{4} - (\frac{1}{8} + 10\frac{3}{4})$
$D = 10.875$ in.

A table was compiled as shown in Fig. 4 similar to that for piston valves, in which it will be observed that due provision is made for adjustment of the back figures in accordance with any variation of the width of the valve

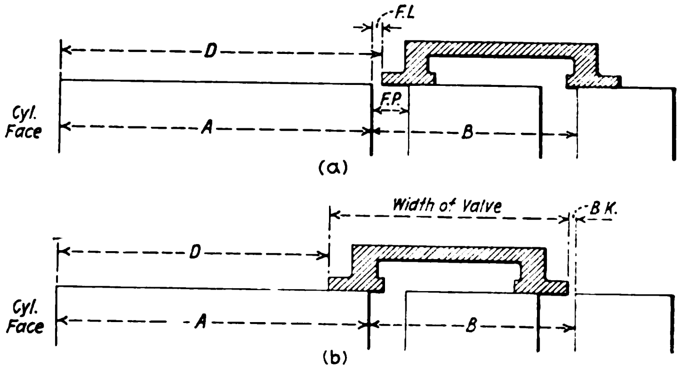


Fig. 3—Front and back dead center positions when setting flat slide valves

from the standard. Thus, for an engine of this class, the actual measurements were found to be:

$A = 12.999$ in.; $B = 8.747$ in.; width of valve 10.753 in.

By using the table we find:

Front figure = 13.249 in.
Back figure = 10.868 in.

In the event of it being found that the measurements taken, when the locomotive is on a particular center in the forward gear, vary to any appreciable extent from those taken on the same center but in the reverse gear, adjustment is made by altering the eccentric blades on the Stephenson gear, and the expansion link on the Walschaert gear. In order to reduce the forward gear lead on the Walschaert valve motion, the expansion link carrier is lowered by reducing the thickness of the liners at the bottom and of course substituting a thicker one at the top. A stock of liners is kept, increasing in thickness by 1/32 in. In order to reduce the forward lead, in case of the Stephenson gear, the eccentric blade of the forward eccentric is shortened.

Table for Valve Setting - Class W Engines with Stephenson Valves

Standard Dimensions A-13", B-8.750, Front Lead ¼", Back Lead ⅛", Width of Valve 10.750"

Front Figures		Back Figures B							Width of Valve						
	A	8.747	8.748	8.749	8.750	8.751	8.752	8.753	10.747	10.748	10.749	10.750	10.751	10.752	10.753
13.247	12.997	10.869	10.870	10.871	10.872	10.873	10.874	10.875	+.003"	+.002"	+.001"	±.000"	-.001"	-.002"	-.003"
13.248	12.998	10.870	10.871	10.872	10.873	10.874	10.875	10.876							
13.249	12.999	10.871	10.872	10.873	10.874	10.875	10.876	10.877							
13.250	13.000	10.872	10.873	10.874	10.875	10.876	10.877	10.878	Note: Add or subtract the above amounts to the back figures in accordance with the actual width of the valve						
13.251	13.001	10.873	10.874	10.875	10.876	10.877	10.878	10.879							
13.252	13.002	10.874	10.875	10.876	10.877	10.878	10.879	10.880							
13.253	13.003	10.875	10.876	10.877	10.878	10.879	10.880	10.881							

Fig. 4—Table for setting valves on a locomotive equipped with the Stephenson gear

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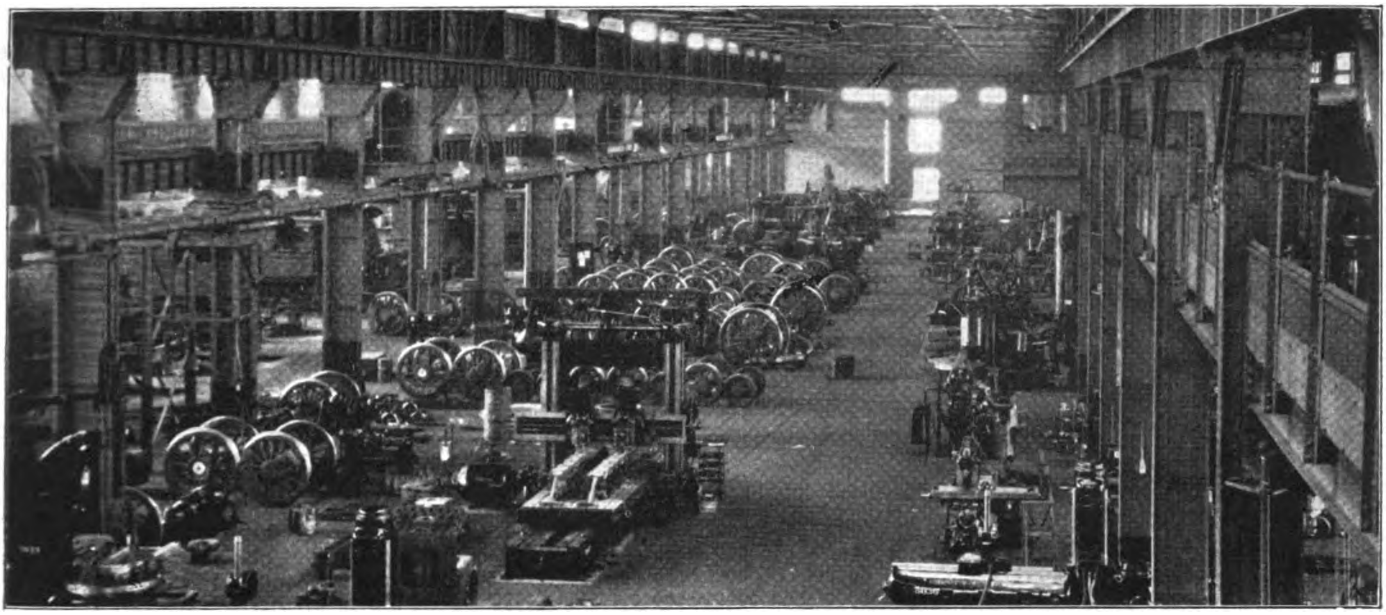
THE SHOP CRAFT EMPLOYEES on the Chicago & North Western have taken a referendum vote on the question whether the co-operative plan introduced on the Baltimore & Ohio and later adopted on the Canadian National shall be put into effect on the North Western. Although the result has not been announced it is expected that the men will favor the plan, since the railway employees' department of the American Federation of Labor strongly advised its adoption. If the adoption of the plan is approved, Capt. O. S. Beyer, Jr., consulting engineer for the unions, who supervised the introduction of the plan on the Baltimore & Ohio and the Canadian National, will make a study of the North Western shops to determine at which point to start the program.

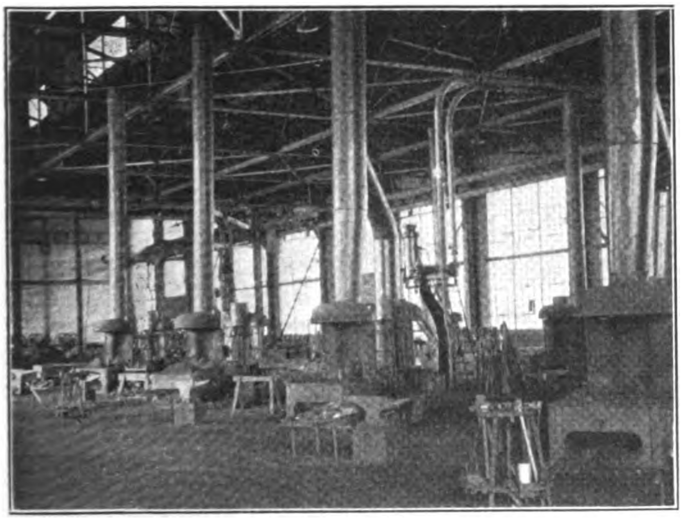


Interior view of the Finley locomotive shops of the Southern Railway, North Birmingham, Ala.

Southern builds modern equipped locomotive shops

Excellent results are being obtained through a system of cost control and inspection

WORK on the first locomotive repaired at the Finley shops of the Southern at North Birmingham, Ala., was completed on October 15, 1924. This locomotive, a Pacific type, was sent into the shops for class three repairs on October 1, 1924, making a total of 13 eight-hour working days between the "day in" and the "day out." The total amount of labor and material expended on this locomotive was 40 per cent less than the cost to perform the same work in the old Alabama Great Southern shops at Birmingham, which formerly handled the classified repairs of the Alabama Great Southern, now a part of the Southern System, and the Birmingham division of the Southern.



Interior view of the blacksmith shop

The repair work of these two divisions was consolidated at Birmingham in 1922. This placed on these shops the burden of maintaining 219 locomotives which eventually required that approximately 20 per cent of the classified repairs be turned over to the shops of other divisions. The working force employed at Birmingham by the mechanical department at that time totaled over 1,500 men. This included the forces employed in both the locomotive and car departments.

New installation has decreased costs

With the new installation at Finley, the mechanical department was able to reduce the working forces in both the locomotive and car departments to 1,138 men, with a staff of 31 foremen and supervisors and 11 clerks, which includes the day and night forces of the two engine houses. In addition, the locomotives of the Memphis and Mobile divisions, the New Orleans & Northeastern Railroad and the New Orleans Terminal Company, now included in the Southern System, are dependent on the Finley shops for classified repairs, making a total of 466 locomotives.

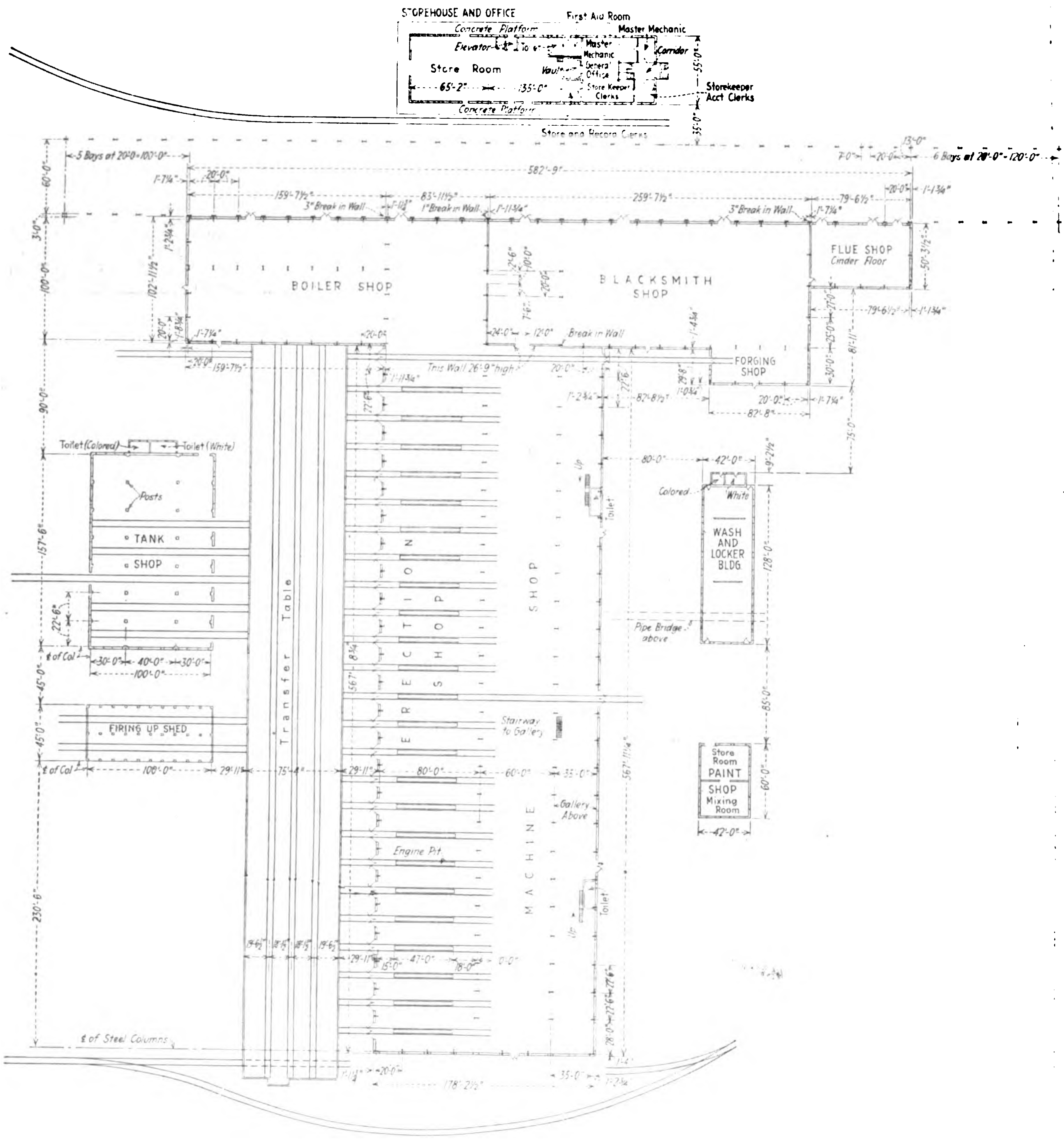
The Finley installation, named after W. W. Finley, president of the Southern from 1906 to 1913, includes both a locomotive and car repair shop. The locomotive repair unit consists essentially of a T-shaped structure in which are housed a 24-pit erecting shop, and machine, boiler, smith, flue and forging shops. Each shop is laid out for its efficient operation as an individual unit as well as in its relationship to each other. As shown in the floor plan of the locomotive repair unit, the boiler, blacksmith,

forge and flue shops are located in the horizontal arm, while the erecting and machine shops are located in the vertical arm of the "T."

The section containing the erecting and machine shops is 178 ft. wide by 568 ft. long. The erecting shop is of the transverse type with a width of 80 ft. and a clear height of 47 ft. to the roof trusses. The locomotive pits, 24 in number, are 47 ft. long. Each pit-track extends 10 ft. into the machine shop area on one side and to a 75-ft. 4-in., electrically operated transfer table on the other. The pit-tracks are 22 ft. 6 in. from center to center.

The machine shop consists of two bays 60 ft. and 35 ft. wide, respectively. The 35 ft. bay is arranged with a gallery floor running the entire length. This floor has landing extensions built out into the crane bay in order that the cranes may be used for handling materials and parts to this floor. The gallery is used for the electrical department, air room, manufacturing tool room, and the tin and jacket shops. The heavy machine tool equipment is located on the main floor. Both the erecting and machine shops have flooring of wood block laid on concrete.

The boiler shop occupies approximately one-half of the section forming the horizontal arm of the "T." The fabricating department of the shop is 100 ft. wide by 240 ft. long, the erecting floor being 80 ft. by 100 ft. The



Floor plan of the Finley locomotive shops at North Birmingham, Ala.

boiler shop is divided into two bays of 40 ft. and 60 ft. each, the latter bay being equipped with a 20-ton overhead crane.

The blacksmith shop occupies the remaining portion of the horizontal arm of the "T." It is 100 ft. wide by 260 ft. long. Two additions at one end of this shop, house a 50-ft. by 80-ft. flue shop and a 30-ft. by 80-ft. section is utilized for the forging machines. The forge shop is served by a track passing along the outside of the blacksmith shop, through the machine and erecting shops and across the transfer table.

Shop buildings are well lighted

All of the shops are well lighted. A large exposure of steel sash is used in all the side walls and in skylights, monitors and clerestories. Electric illumination is provided by the installation of overhead reflectors with 500-watt lamps spaced approximately 25 ft. apart.

Wash and locker facilities have been provided for in a 42-ft. by 128-ft. brick building located near the machine and forge shops. Toilet facilities have been provided for within the shops, the main installation being on two intermediate or mezzanine floors located in the machine shop, between the main and gallery floors, as shown in the drawing on page 168.

The location of the various shops has been planned with a possible need for future expansion. Sufficient space has been left to permit another erecting and machine shop to be built on the opposite side of the transfer table. For this reason the construction of the tank shop and the firing up shed now on the opposite side of the transfer table is of a temporary nature. Both buildings are constructed of timber, the former having five tracks, of which one is a through track, and the latter having two tracks. They are respectively 100 ft. by 157 ft. 7 in. and 100 ft. by 45 ft. in dimensions.

The storehouse and office building—Assembly room for instruction classes is provided

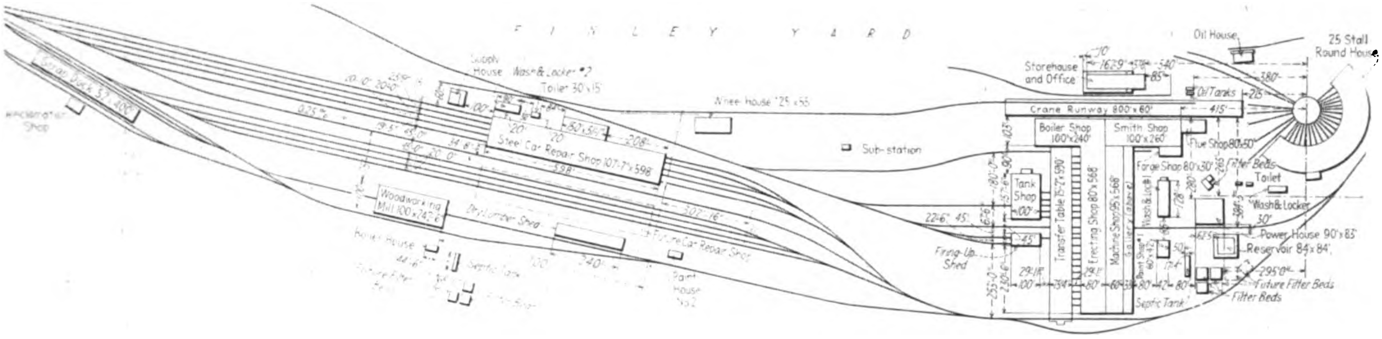
The combined storehouse and office building is a two-story structure of pleasing appearance. One end is devoted to the offices of the master mechanic and division storekeeper and the other to the storeroom. It is of concrete and brick construction with concrete platforms extending across one end and for about three-fourths the length of the building on each side. It is 210 ft. long by 55 ft. wide, the office section occupying approximately one-third of the total length of the first floor and approximately one-fourth of the second.

A large assembly room is also located on the second floor of the office building which provides excellent accommodations for staff meetings, instruction classes and a meeting place for the various shop committees.

A well equipped first aid room, in charge of a trained nurse, is located on the first floor between the offices of the master mechanic and the storeroom.

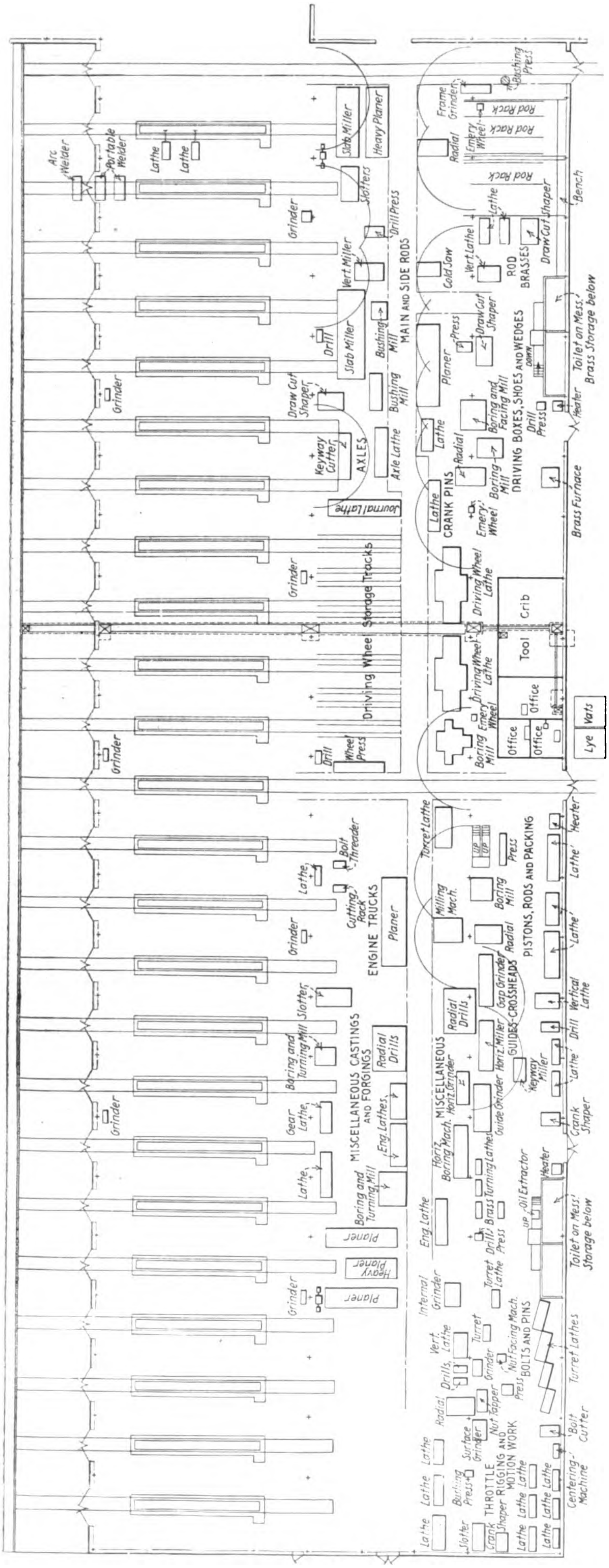
The space between this building and the locomotive shops is utilized for a casting yard. It is served by a 20-ton crane, one runway of which is carried on the walls of the shop buildings. This craneway is now 800 ft. long but it is planned to extend it so that it will also serve the wheel shop of the car repair unit.

The power house equipment consists of three 420-hp. boilers with stokers and forced draft. Overhead coal bunkers are provided which feed directly to the stokers. Two sets of hoisting equipment have been installed, one for elevating the coal to the bunkers and one for carrying up the ashes from the basement to an overhead bin, which in turn, provides some storage and gravity loading

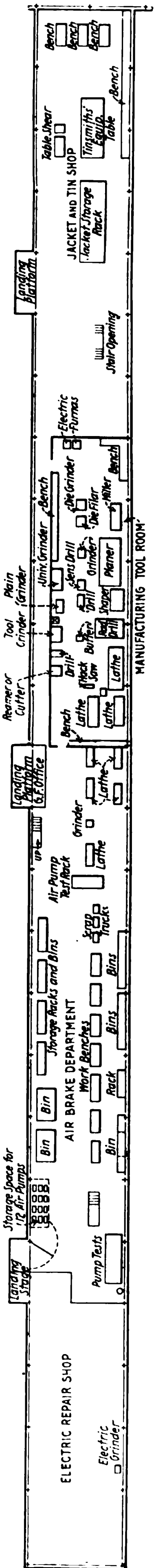


General plan of the Finley locomotive and car shops, North Birmingham, Ala.

An aeroplane view of the locomotive shops, showing the relative location of the engine house to the machine shop

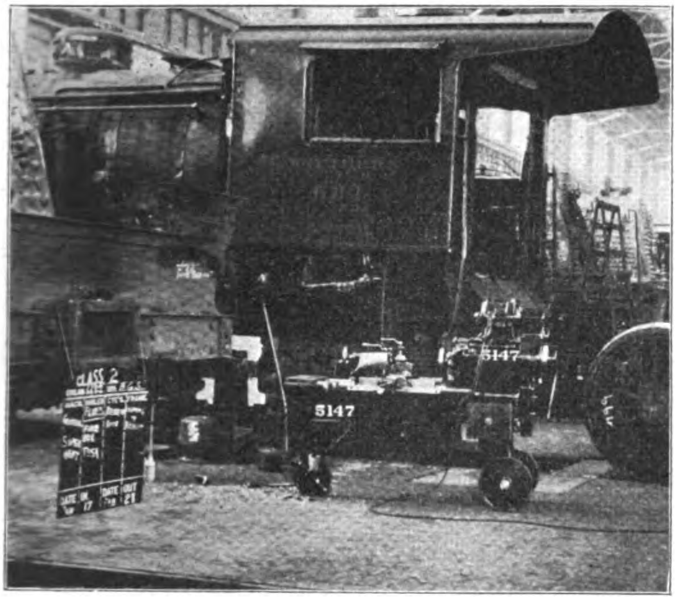


Floor plan of the machine and erecting shops, showing the machine tool layout



Machine tool and equipment layout of the air brake department, manufacturing tool room and tin shop

into the cars. The air compressor units consist of a 2,500-cu. ft. steam driven unit and a 1,500-cu. ft. motor driven unit. Exhaust steam is utilized in unit heaters which are placed along the walls and along the interior lines of the columns of the various shop buildings. A



A bulletin board showing the principal jobs to be done is hung on each locomotive

turbine generator of 300 kw. capacity has been installed in the power house for use in case of emergencies.

Excellent crane service is provided

One of the features of this installation is the excellent crane service that has been provided for all departments. partitioning wall between the two. Jib cranes have been installed to serve machines that are used for heavy material. A transfer table is provided for the transfer of engines to the erecting shop pits and the firing up shed. The same table also serves the tank shop. The boiler shops and the blacksmith shops are equipped with a full complement of heavy and light overhead cranes for the handling of boilers, hot forgings and heavy parts.

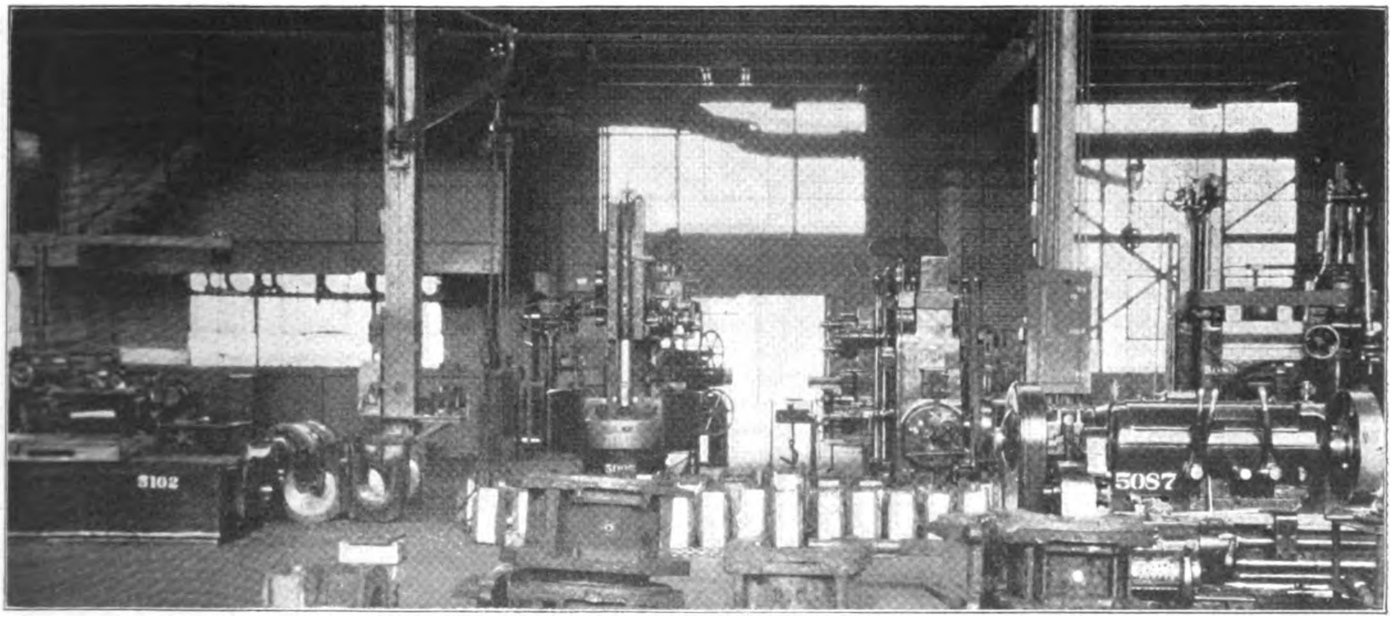
System of handling work in the erecting and machine shops

Only classified repairs are handled in the erecting shop. As soon as a locomotive is brought in for repairs, the wheels are removed and placed on the wheel storage tracks which are located in the center of the wheel shop. Each erecting gang does its own stripping and routes the various parts to the proper departments where they are inspected for repairs or scrapping. The brake and spring rigging are annealed upon arrival at the blacksmith shop and then inspected by the foreman. Valve motion parts, rods, crossheads, guides, etc., are removed by the stripping gang, sent to the lye vat for cleaning and are then routed to the various departments in the machine shop.

A work report of work to be done on each locomotive is sent to the general machine shop foreman by the erecting shop foreman. This report is then analyzed and the necessary instructions are transmitted to each sub-department head, by the general machine shop foreman.

A regular system of shop scheduling has not as yet been installed. However, a careful check is kept on the progress of the work in each department to see that the results correspond to the outgoing date of the locomotives. All material sent to the machine shop for repairs is carefully checked by the head of each department and inspected for limits and standards.

The work of unwheeling and transferring the boilers and cabs to the boiler shop is handled by the overhead



Interior view of the driving box department

The erecting shop is served by one 150-ton crane with a span of 77 ft. and two 15-ton overhead cranes with a span of 75 ft. which can be operated the entire length of the unit and into the boiler shop. The 15-ton traveling cranes of 56-ft. span are also provided for the machine shop which can also be operated the full length of the unit and into the blacksmith shop through an opening left in the cranes. A rack, which is shown in one of the illustrations, has been provided for front end covers. This rack is of sufficient strength to permit its being moved when loaded to capacity by a crane to any place desired. A high platform truck is used in the work of removing super-heater units.

Portable engine lathes are used for fitting frame bolts

in the erecting shop. Bolts are drawn from stock, cut to length and are delivered to the bolt department where they are centered on a centering machine. They are then turned to a fit on the small portable engine lathe and then threaded. Considerable attention is paid to the accuracy of these fits and with the lathe located close to the locomotive, it is thought that more satisfactory individual fits can be made, rather than by manufacturing the bolts in quantity to certain standards and then reaming the holes to fit the bolts.

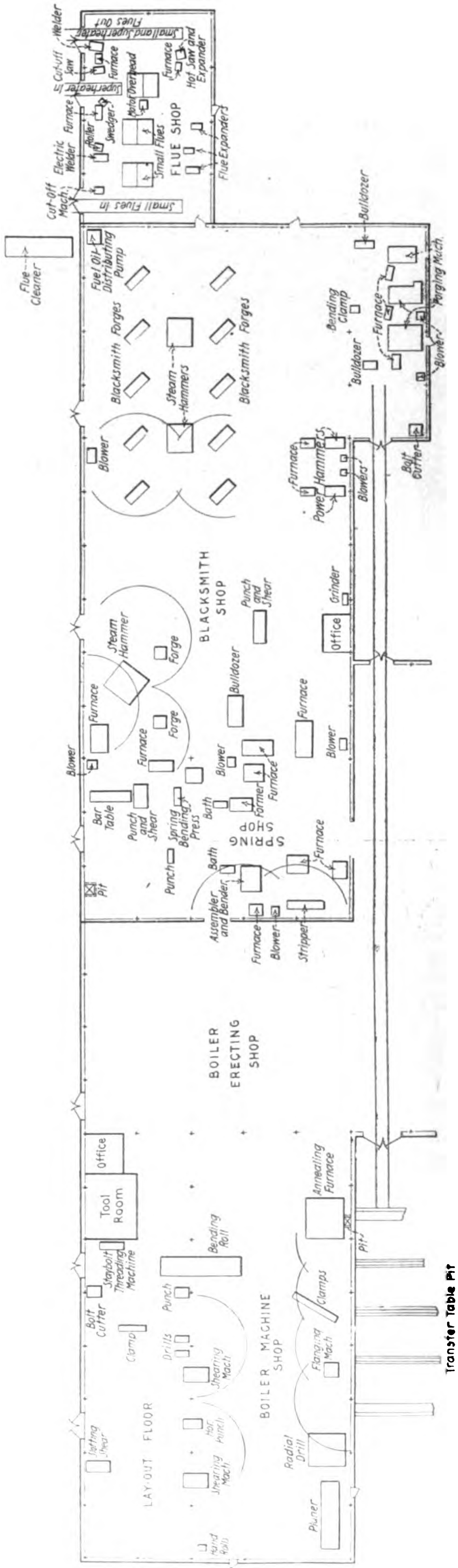
A feature of the supervision of both the erecting and machine shops is the bulletin board placed on each locomotive undergoing repairs. This bulletin board, one of which is shown in an illustration, has space provided for entering the important items of repairs that are being made on the locomotive. The class of repairs is shown at the top of the board. Directly underneath is shown the number of the locomotive and the division to which it is assigned. Four columns for listing the repairs to the machinery, boiler, cylinders and frame are ruled vertically and sufficient space is left at the bottom to show the incoming and outgoing dates. These boards are hung on the end of each locomotive towards the machine bay. The information on these boards enables the master mechanic and his assistants to check immediately the progress of the work on each locomotive and in cases where unsatisfactory progress is shown, to take prompt measures towards improving the situation.

Progress reports are made at weekly staff meetings

A meeting of the supervisory forces is held on Friday of each week. Each department head submits a report of the progress of the work for each locomotive that is being performed in his department. Each foreman, knowing the progress of the work going through the various other departments, can then adjust the work under his supervision so that there will be no delay in the outgoing date of the locomotive from the erecting shop. The success of this system is shown by the fact that there have been comparatively few variations from the outgoing dates originally set since the Finley shops have been placed in operation.

Daily report of labor and material expenses is made to the master mechanic

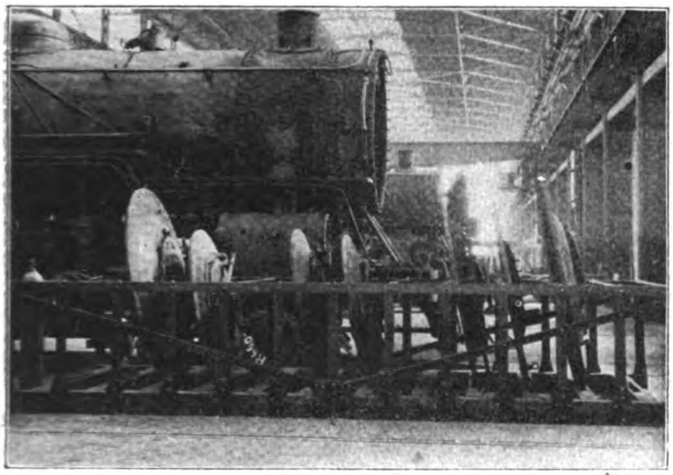
Frequent inspection trips are made through the shop each day by the master mechanic. These inspections enable him to make a note of any unsatisfactory condition and to take proper steps towards its elimination. These inspections are supplemented by a system of labor and material expense control. As soon as a locomotive is brought into the erecting shop for repairs, a record is kept of labor and material expenditures for each day. All work performed in the various departments of the machine, boiler, smith and flue shops is charged direct to the locomotive. Data for these costs is collected by each department foreman from the time cards of the men and requisitions that have been filled by the stores department. These expenses are compiled for each day by a clerk in the master mechanic's office who enters the day's total along with the grand total of labor and material expenditures, on each locomotive to-date, on a chart which is laid on the master mechanic's desk each morning. This chart is ruled with columns for each locomotive in the shops. At the extreme left is a column listing the days of the month, each date being assigned to a separate line sufficiently wide to accommodate both the daily and grand total figures. A column at the right of the column showing actual labor and material expenditures shows the allowance made by the stores department for scrap. The actual expense for repairing each locomotive is obtained



Machine tool and equipment layout of the boiler, blacksmith, forge and flue shops

by subtracting the amount shown in the left-hand column from the amount shown in the right-hand column and this figure is entered in a third column.

No account is taken of shop expense or overhead items as the object of this report is to give the master mechanic a basis upon which to estimate the efficiency and progress of shop production. In other words, the principal value of the figures shown in the report is obtained by comparison with previous expenditures for similar class repairs.



A rack for front end covers designed to be moved by crane

When necessary, the master mechanic is also able to determine quickly the total cost of each day's operation. General overhead charges are kept on a separate record to which the master mechanic can refer at any time. Although considerable emphasis is laid on keeping production costs down, quality of workmanship is not sacrificed in the least. Careful inspection of all work by the department foremen, supplemented by frequent inspections by the master mechanic and general machine shop foreman insures a high standard of workmanship.

Castings and heavy materials are stored in a yard provided with overhead crane service—Platforms for the storage of material are being built in this yard

Machine tools are motor driven

Practically all the equipment used in these shops is electrically operated, alternating current being supplied for the machine tools, yard cranes and transfer table. Direct current is used for the cranes in the locomotive shops. The power, which is purchased locally, is alternating current and is stepped down and used where needed. The current is used also to drive two 150-kw. motor-generator sets for the supply of direct current.

The shop is very largely equipped with the latest design of machine tools and shop equipment. A few machine tools of more recent design were moved from the Alabama Great Southern shops. The large machine tools designed to work on heavy parts are located where they can be served by the 15-ton cranes. The smaller machine tools and work benches are placed beneath the gallery floor and jib cranes have been installed at various strategic points to assist in the handling of material.

The rod department is located at the end of the machine shop next to the blacksmith shop. This location makes it comparatively easy to route the rods directly from the smith shop for finishing without back-tracking or interfering with the work of other departments. Rods are completely finished and bushed in this department from whence they are routed directly to the locomotives in the erecting shop. Racks are provided that hold the rods, to which bushings are being fitted, at a convenient height for calipering and trial fitting.

The repair units for driving boxes, shoes and wedges, crank pins and axles are located in close proximity to each other. Each unit is complete in itself and the various machine tools and shop equipment are located so as to facilitate the work of each department. The axle lathes are located where they can be served advantageously by the 15-ton cranes from and to the adjacent wheel department. The driving box and shoe and wedge departments extend beneath the gallery floor. Driving boxes are bored and faced in the same operation on a Sellers vertical boring mill. This job from floor to floor has been performed in 9 min. Eccentric grooves are cut for holding the brass liners to the driving box face. These grooves are cut 2½ in. wide at the top and are then narrowed down to 2 in. at the bottom. By the use of this method it is unnecessary to drill holes in the face.

Shoes and wedges are gaged end to end on the platen of a planer. A jig that will hold four tools is now being built so that both the inside and outside surfaces can be finished at the same time.

Two large driving wheel lathes are located at the ends

of the wheel storage track. All of the machine tools in the wheel department are grouped around the wheel storage track so that they may be readily served by the 15-ton cranes. As the machine shop is also required to handle the work of the enginehouse, provisions have been made in the wheel department to turn unmounted tires. A jig has been devised for holding the tire to the face plate, as shown in Fig. 1. This device is of heavy construction and is secured by means of bolts, the heads of which are inserted in the grooves of the face plate. The clamp *B* which pivots on the pin *D* is tightened against the tire by means of the wedge *A*. The tire is held securely by the clamp against the shoulder *E*. The average time for turning engine truck wheels is 20 min.

The piston rod, guide and crosshead, throttle rigging and motion work departments are arranged in order of work from the wheel department to the end of the shop. Provision has been made to handle miscellaneous castings

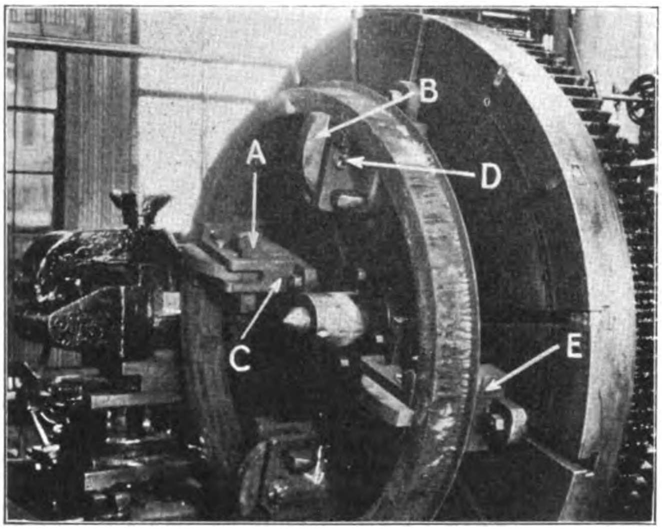
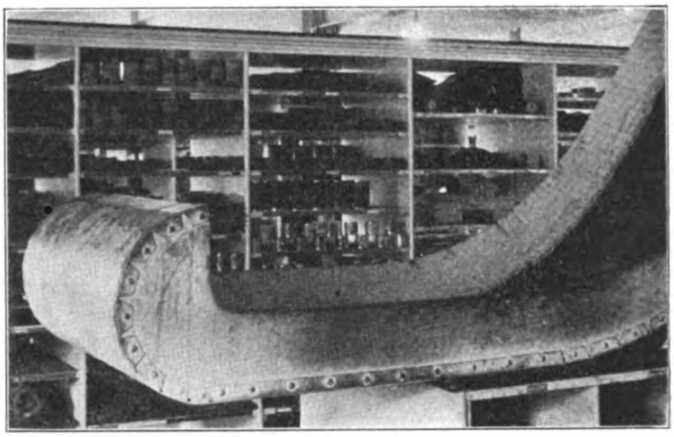


Fig. 1—Jig for holding unmounted tires on the face plate of a wheel lathe

and forgings on a separate group of machine tools. Valve packing rings are finished by chucking them in a 16-in. lathe. Piston rods are ground on an 18-in. by 30-in. by 96-in. Morton cylindrical grinder. A 4-in. Diamond face grinder is used for finishing guide bars, etc. All motion work pins, crosshead pins and knuckle pins are rough turned from the bar and then threaded.

The toolroom is divided into two sections. The repair or manufacturing section is located on the gallery floor while the disbursing toolroom is located directly beneath on the floor of the machine shop. Communication is provided between the two units by a dumbwaiter type of small hand elevator.

Disbursements are made by means of the check system. Tools requiring repairs or grinding are placed in the dumbwaiter by the disbursing unit attendant and hoisted to the manufacturing unit above. Reconditioned tools are



Articles stocked on the second floor of the storehouse are sent to the delivery window by a chute

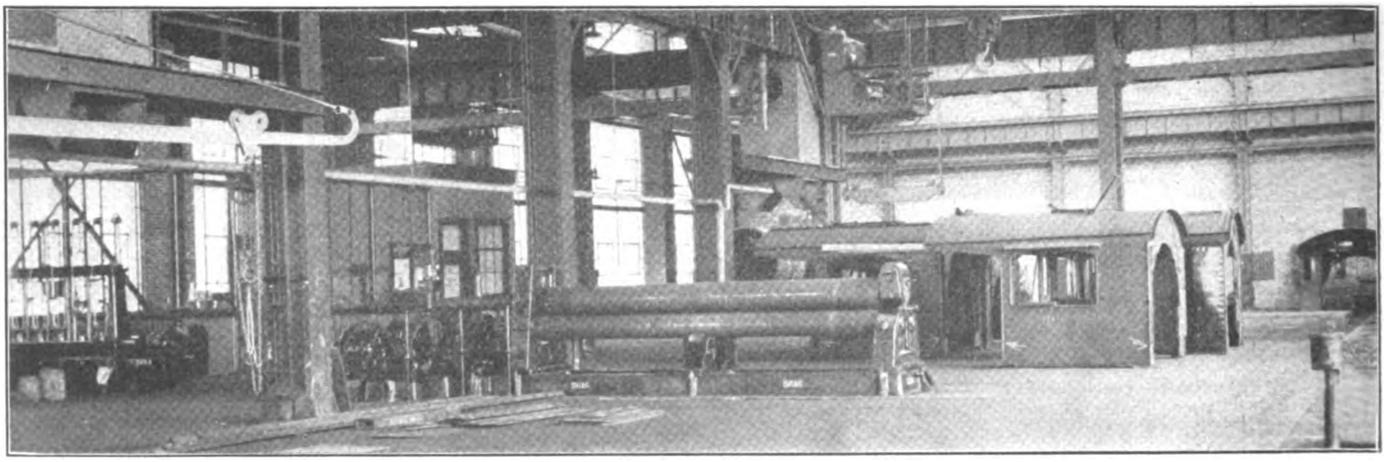
transferred to the disbursing unit below by the same method.

Boiler and flue shop work

The location of the boiler shop with respect to the erecting shop makes it comparatively easy to lift the boiler from the frame and move it to the boiler shop by crane.

Cab repairs are also made in the boiler shop. Boiler sheets are flanged cold on a ¾-in. McCabe pneumatic flanging machine. In this shop, which is well equipped to take care of heavy boiler repairs, is a 48-in. reinforced shearing machine, a Southwark horizontal bending roll, a six-spindle staybolt threading machine, a 16-ft. plate edge planer, a 6-ft. Ridgeway radial drill, and six 2-in. double Acme bolt cutters, all of which are new machines.

The flue shop is located at the opposite end of the horizontal arm of the "T" from the boiler shop. It is well equipped and organized to handle work on a production basis. Flues are handled from the erecting shop to the flue shop by means of a carrier built somewhat in the form of a large basket, which can be picked up by crane. The carrier is placed on a truck and taken by rail directly to the flue shop. Two different gangs are employed, one on tubes and the other on flues, the arrangement of the



Interior view of the boiler shop

machinery being such that all movements are in a straight line as much as possible, thereby eliminating excessive handling. All tubes and flues are tested after being welded.

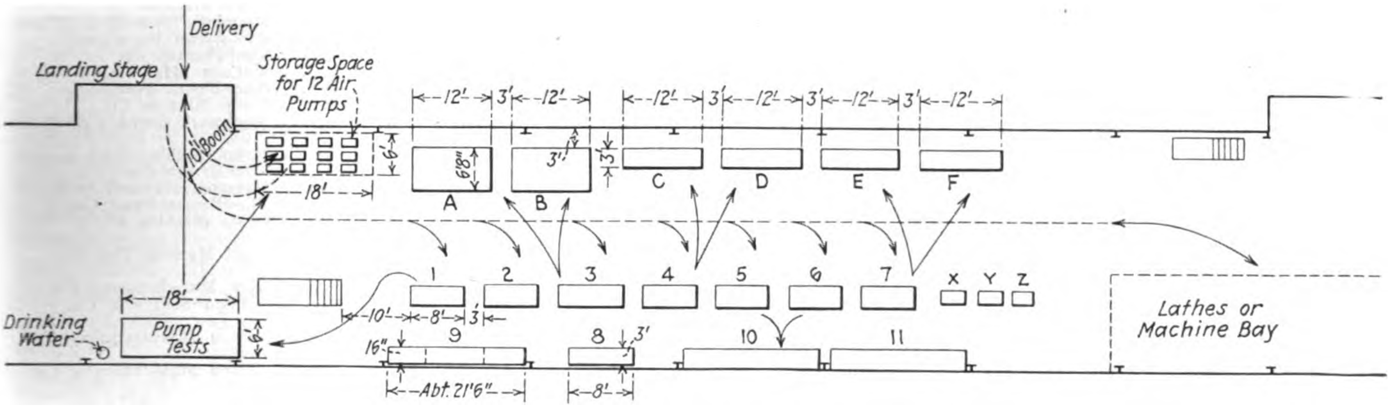
The blacksmith shop

The blacksmith department, located between the boiler and flue shops, is well arranged for efficient performance. Two 1,500-lb. single frame steam hammers are located in the center aisle between two lines of forges. A 3,400-lb. hammer for handling rods and heavy forgings is also provided. An 18-in. double-end punch and shear, and a reverse bulldozer is also included in the new equipment.

The forge shop is located in a bay which is served by a track running through the machine shop. Many locomotive forgings are made in the blacksmith shop of scrap material, such as tender drawbars, binders, equalizers and other parts requiring this kind of material. Radial staybolts used in the boiler shop are upset on special machine tools and dies. The new equipment in the forge shop includes a 3½-in. Ajax heavy-duty twin geared forging machine and a 1⅞-in forging machine.

The air brake department

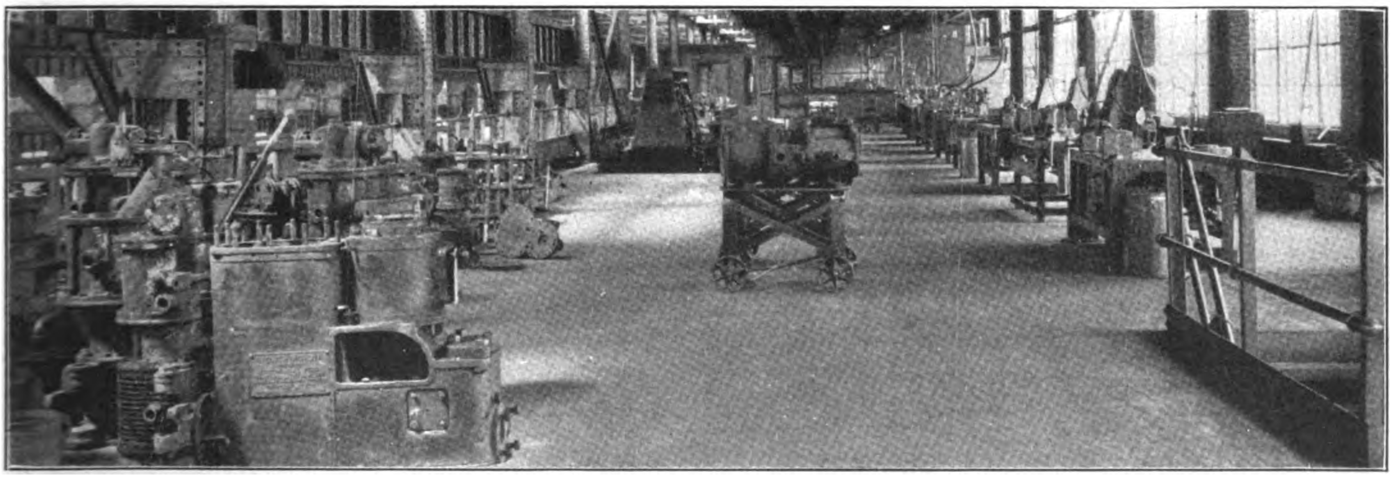
A feature of the shop operation is the organization of the work in the air brake department. This department is located on the gallery floor of the machine shop. Material is delivered by one of the machine shop cranes to a landing stage which projects out into the machine shop bay. The various parts are routed, as indicated by the dotted liens shown in the floor plan of the air brake department. Benches equipped with tools and facilities for repairing air pumps, power reverse gears, injectors and lubricators, cab cocks, feed valves and governors, miscellaneous air brake parts, and valve stems and piston packing are arranged along the outside wall in the order named. Suitable storage bins arranged along the gallery rail have been provided for storing the various parts handled in the department. Scrap brass, steel and cast iron are deposited in separate three-wheeled trucks.



Drawing showing a proposed routing of work through the air brake department

1—Air pump bench.
2—Power reverse bench.
3—Injector and lubricator bench.
4—Cab cocks.
5—Feed valve and governor bench.
6—Miscellaneous air brake bench.
7—Valve stem and piston packing bench.
8—Triple decked storage rack for gages on top deck, safety valve on middle deck, and whistles on lower deck.
9, 10 and 11—U-shape material bin.
A and B—Storage bins for injectors and lubricators.
C and D—Storage bins for cab cocks.
E and F—Storage bins for valve stem and piston packing.
X—3-wheel truck for brass scrap.
Y—3-wheel truck for steel scrap.
Z—3-wheel truck for cast-iron scrap.

Portable benches or wagons for air pumps and feedwater heaters, a number of which are shown in the interior view of the air brake department, have been provided. Holes are punched in the top to suit the different sizes of air pumps and feedwater heaters so that the work can be bolted securely to the wagon. By using this wagon the pump or heater undergoing repairs can be moved from bench to lathe, or vice versa, according to the needs of the mechanic.



The air brake room is located on the gallery floor of the machine shop—Portable benches have been provided for air pumps and feed-water heaters

The stores department

The organization of the stores department is closely in-

List of New Machine Tools Installed in the Finley Locomotive Shops of the Southern Railway, North Birmingham, Ala.

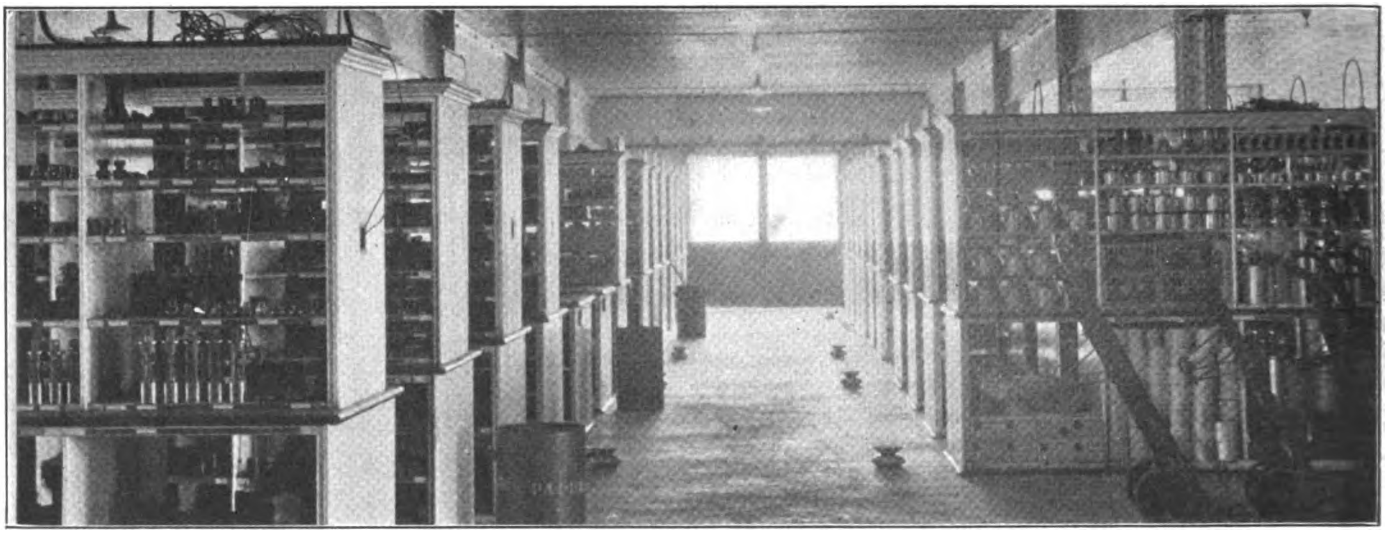
No.	Description	Manufacturer or jobber
1	Chaser grinder	P. H. McArdle Equipment Co.
1	Sundstrand internal radius length and surface grinder	Manning, Maxwell & Moore.
1	Lucas cold saw	Carbon Steel Co.
1	16 ft. Plate edge planer	Consolidated Machine Tool Corporation of America.
1	Tool grinder with Morton clamp center emery wheel	William Sellers & Co.
1	30 in. by 14 in. Quick change gear lathe	Cincinnati Lathe & Tool Co.
1	18 in. by 10 in. Quick change gear lathe	Cincinnati Lathe & Tool Co.
1	Jackson duplex typeless die linker	Walcott Lathe Co.
2	Motor driven wet tool grinder	Safety Emery Wheel Co.
1	3 in. Drill grinder	William Sellers & Co.
1	Springfield Mfg. Co. frame grinder	D. Nast Machine Co.
2	3 in. by 36 in. turret lathes cross feed	Jones & Lawson Machine Co.
1	6 ft. Ridgeway radial drill	Niles-Bement-Pond Co.
1	3,400-lb. Single frame steam hammer	Niles-Bement-Pond Co.
1	Double head axle lathe	Niles-Bement-Pond Co.
1	36 in.-44 in. Side head boring mill	Niles-Bement-Pond Co.
2	1,500-lb. single frame steam hammer	Niles-Bement-Pond Co.
1	44 in. Vertical boring and turning mill	Niles-Bement-Pond Co.
1	53 in. Boring and turning mill	Niles-Bement-Pond Co.
1	Universal collar hexagon turret lathe	Warner & Swasey Co.
6	2 in. Double Acme bolt cutter	Niles-Bement-Pond Co.
1	4½ in. Four-spindle Acme nut tapper	Niles-Bement-Pond Co.
1	48 in. Putnam car wheel borer	Manning, Maxwell & Moore.
2	18 in. Dresses universal monitor lathe	Manning, Maxwell & Moore.
1	20 in. Mechanics back geared compress drill press	C. A. Thumb.
1	28 in. Mechanics Rockford back geared compress drill press	C. A. Thumb.
1	18 in. by 10 in. Heavy engine lathe	Cisco Machine Tool Co.
1	48 in. Reinforced shearing machine	Cleveland Punch & Shear.
1	18 ft. by 8 ft. Bayer & Emmes heavy duty lathe	Manning, Maxwell & Moore.
1	90 in. Driving wheel lathe	Niles-Bement-Pond Co.
1	16 in. by 36 in. Pratt-Whitney Model B tool room lathe	Niles-Bement-Pond Co.
1	12 in. by 30 in. Pratt-Whitney Model B tool room lathe	Niles-Bement-Pond Co.
1	18 in. by 30 in. by 96 in. Grinding machine	Norton Company.
1	18 in. by 8 ft. Heavy duty geared head engine lathe	American Machine Co.
1	Car wheel lathe	Niles-Bement-Pond Co.
1	Reverse bulldoser	Williams, White & Co.
1	84 in. Diamond heavy bar grinder	Manning, Maxwell & Moore.
1	Victor nut facing machine	Manning, Maxwell & Moore.
1	18 in. Double end punch and sheer	New Doty Manufacturing Co.
1	42 in. by 14 ft. Reversing drive planer	Niles-Bement-Pond Co.
1	30 in. Vishold vertical boring and turning mill	Wind Machine Co.
2	24 in. Bement slotter	Niles-Bement-Pond Co.
1	500-lb. Bradley upright helve hammer	Niles-Bement-Pond Co.
2	500-lb. Bradley upright helve hammer	Niles-Bement-Pond Co.
2	36 in. by 16 ft. LeBlond engine lathe	Niles-Bement-Pond Co.
2	15 in. by 6 ft. LeBlond engine lathe	Niles-Bement-Pond Co.
1	17 in. by 6 ft. LeBlond engine lathe	Niles-Bement-Pond Co.
1	600-ton Hydrostatic wheel press	Southwark Foundry & Machine Co.
1	Oster threading machine	Kemp Machine Co.
1	14 in. Allen high speed sensitive drill	Manning, Maxwell & Moore.
20	Blacksmith forge, complete	Ross-Nehan Foundries.
1	24 in. by 14 ft. Lathe	Reed-Prentice Co.
1	¾ in. Pneumatic flanging machine	McCabe Mfg. Co.
1	26 inch Libby turret lathe	Niles-Bement-Pond Co.
1	Cincinnati milling machine	Kemp Machine Co.
1	Southwark horizontal bending roll	Southwark Foundry & Machine Co.
1	Cincinnati Universal milling machine	Kemp Machine Co.
2	6 ft. Plain radial drill	Niles-Bement-Pond Co.
2	Dresses 20 in. universal monitor lathe	Manning, Maxwell & Moore.
1	Niles 100-ton bushing press	Niles-Bement-Pond Co.
1	32 in. Crank shaper	Kemp Machine Co.
1	24 in. by 12 ft. Geared head heavy duty engine lathe	Cisco Machine Tool Co.
1	3½ in. Heavy duty twin geared forging machine	Ajax Manufacturing Co.
1	54 in. Boring and facing machine	William Sellers & Co.
1	Draw cut railroad shaper, with rod brass attachment	Morton Manufacturing Co.
1	36 in. Draw cut pillar type shaper, with wedge box attachments	Morton Manufacturing Co.
1	32 in. Draw cut pillar type shaper turret lathe	Morton Manufacturing Co.
1	90 in. Locomotive axle and journal turning lathe	Niles-Bement-Pond Co.
1	Horizontal milling machine	Newton Machine Tool Works.
1	Niles 36 in. to 44 in. Side head boring mill	Niles-Bement-Pond Co.
1	Flue cleaner	Jos. T. Ryerson & Son.
1	Six-spindle staybolt threading machine	Harrington Company.
1	Grinder, ½ hp. floor type motor	Vandyle, Churchill Co.
1	36 in. by 36 in. by 10 ft. Planer	Niles-Bement-Pond Co.
1	Single vertical adjustable milling machine	Ingersoll Milling Machine Co.
1	36 in. by 36 in. by 14 ft. Pond planer	Niles-Bement-Pond Co.
1	42 in. by 30 in. by 16 ft. Horizontal milling machine	Ingersoll Milling Machine Co.

terlocked with that of the mechanical department in the management of the Finley shops. In order to prevent overstocking and ordering of material that is not being used, a careful check is made of all material on hand by the stores department. Daily reports are made to the stores department by the mechanical department as to what material will be needed in the future and the approximate date.

It is planned to install a delivery system, operated by attendants who will wear red caps, on a 15-min. schedule. The object of the red caps is to easily distinguish the men charged with the responsibility of delivering and collecting material, from the other workmen. Many instances occur when it is desired to expedite a requisition and considerable time can be saved by not having to hunt for a delivery man. Stations will be established in each department provided with a hook for requisitions and bins for the collection of scrap.

Fuel oil is stored in a large tank located near the oil house. Deliveries are made by pipe lines to various stations in the shop. An inventory is taken every 30 days and the amount used is charged to the mechanical department.

At present time requisitions for material from the storeroom are filled at a delivery window opening onto the platform on the side of the stores building next to the boiler-



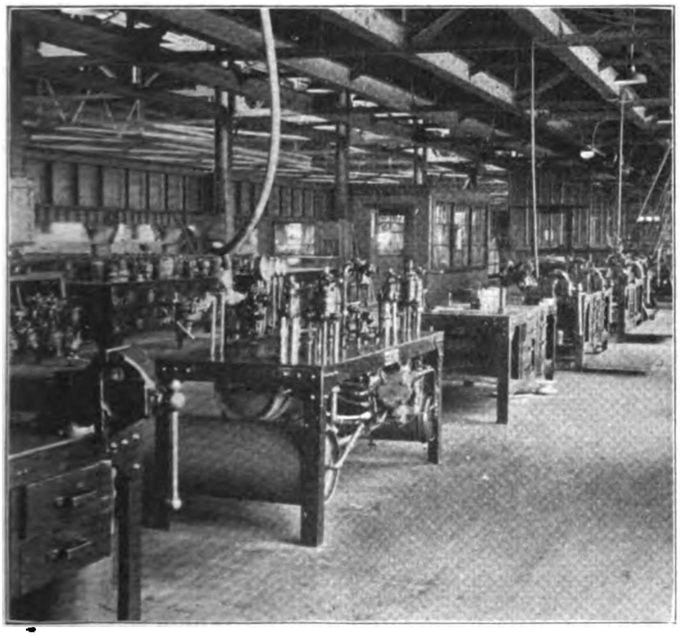
The store room is equipped with open shelves—The unit piling system is employed

shop. The interior arrangement of shelves, racks and bins is well planned and the unit system of piling is used for practically all material. Articles on requisitions for material stored on the second floor are delivered to the attendant at the delivery window by means of a chute. An elevator, with a direct entrance from the outside platform, is also provided for the conveyance of trucks and heavy material to and from the second floor. A cage for storing tools and other valuable material is located on the second floor. Only one key to the door of this cage is issued at a time and it is given to one man who is held responsible for all material contained therein.

Results accomplished since starting operation

Mention should be made of the exceptional results that have been accomplished in the Finley shops as compared to the old system of handling repairs in the shops of the Alabama Great Southern. As previously mentioned the first locomotive undergoing class three repairs at Finley was turned out of the shops in 13 eight-hour working days at a total reduction in cost of labor and material of approximately 40 per cent over the cost to do the same work in the old shops. At the present time class three repairs average 18 days, a reduction in time over the old record of from 45 per cent to 50 per cent and a reduction of labor and material expense of 43 per cent. The cost of applying a new firebox, including general repairs to machinery, has been reduced by 33½ per cent to 40 per cent. Similar reductions have also been accomplished in practically all classes of repairs.

No small share of the credit can be given to the excellent spirit of co-operation and interest that has been shown by the men and the supervisory forces. This spirit is due largely to the efforts of C. E. Keever, master mechanic, Finley shops, and H. W. Miller, vice-president, who personally placed the shops in operation on October 1, 1924, at which time there were 12 locomotives awaiting repairs. The new shops were planned under Mr. Miller's general direction, the machine tool and mechanical department details being worked out under the direction of R. L. Ettenger, mechanical assistant to the vice-president.



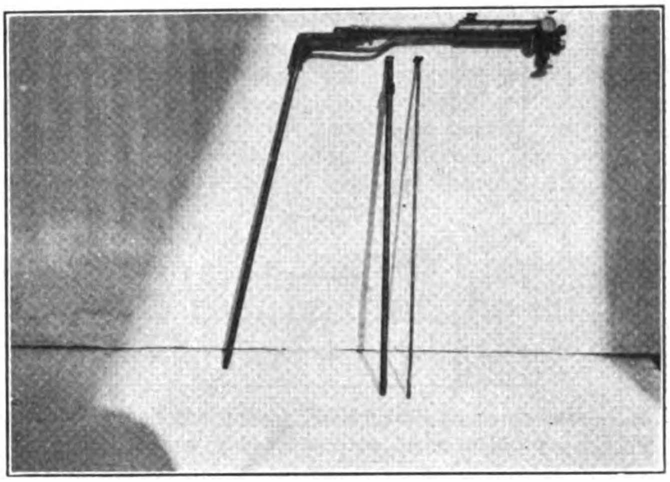
Interior view of the air brake department—Triple valve test rack in the foreground

Saving time with an acetylene cutting torch

By David Pearson

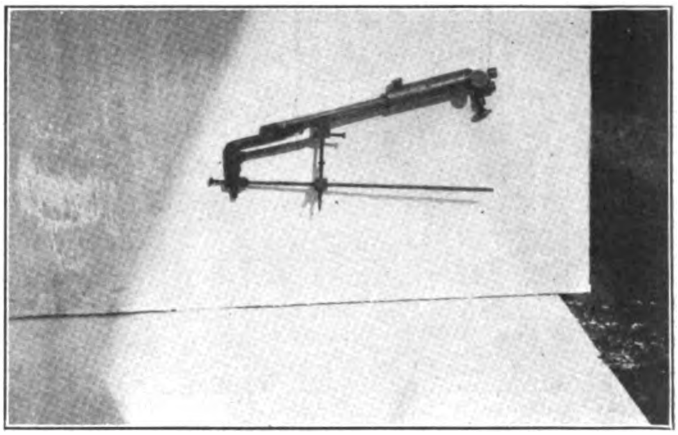
Welder foreman, Atchison, Topeka & Santa Fe, San Bernardino, Cal.

CUTTING circles with a hand acetylene cutting torch is a tedious, crude operation at the best. The operator experiences great difficulty in keeping his hand steady enough to produce an even cut. Fig. 1 shows a simple arrangement whereby these objectionable features are greatly reduced thus effecting a considerable saving in time and labor. The device consists of a radius bar one end of which is fixed to the torch tip. There slides along this bar a pivot bar one end of which fits over and slides along the acetylene pipe of the torch. Suitable adjustments are provided to take care of the various radii.



Extended cutting tip for getting into inaccessible places

The acetylene operator is often confronted with the problem of trying to reach inaccessible places with the cutting torch. Fig. 2 shows an extension tip for reaching such places. It is made from a piece of copper tubing and a rod. One end of the tubing is threaded and fitted with a nipple which is screwed in where the cutting tip normally goes. The rod fits inside of the tubing. These extensions have been used to lengths of 10 and 20 ft. The device can be readily used in connection with boiler repair work.



Attachment for cutting circles with an acetylene torch

Tool for machining ball rings on a lathe

Ball rings shaped like the one shown in Fig. 1 are sometimes used in connection with piston rod packing, valve stem packing, and at other places on steam locomotives. The shape of the rings presents no particular difficulty in machining operations when they are made in such quantities as to justify tooling up a machine suitable for the job. But when they are finished on an engine lathe and shaped to a template, the results are not always satisfactory. Changing the parting tool and forming tool requires careful adjustment each time a change is made. This method involves repeated trial cuts and settings, with attendant loss of time.

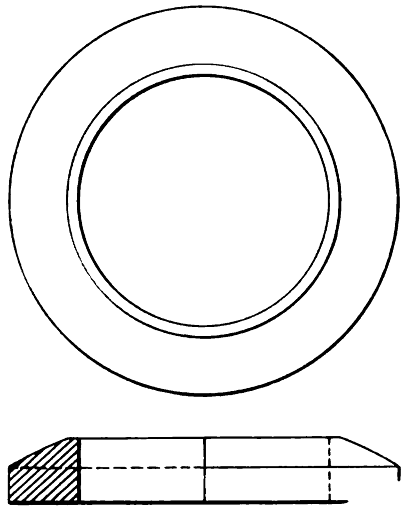


Fig. 1—Ball rings, as shown here, present a difficult machining problem when not produced in quantity

The tool shown in Fig. 2 is made by chucking or clamping to the face plate of a lathe a piece of tool steel of suitable section and by boring the radius *A*. Care must be taken in setting the piece to place it in such position as to have the radius extend beyond the diameter of the rings to be machined. After the radius *A* is completed the work is reset and the radius *B* is machined, as shown in Fig. 2, half through the thickness of the piece, reversing the operation on the opposite end. This brings the cutting edges of the opposite ends along the center line, insuring the contour of the finished work to be of suitable radius.

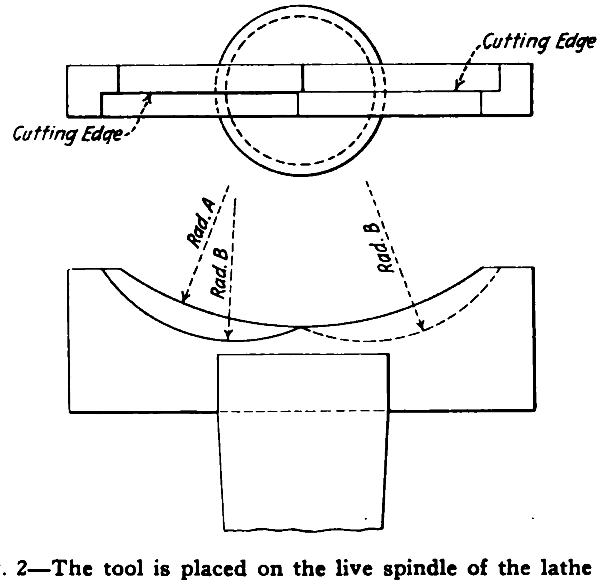


Fig. 2—The tool is placed on the live spindle of the lathe and adjustments can be made by moving the tail stock

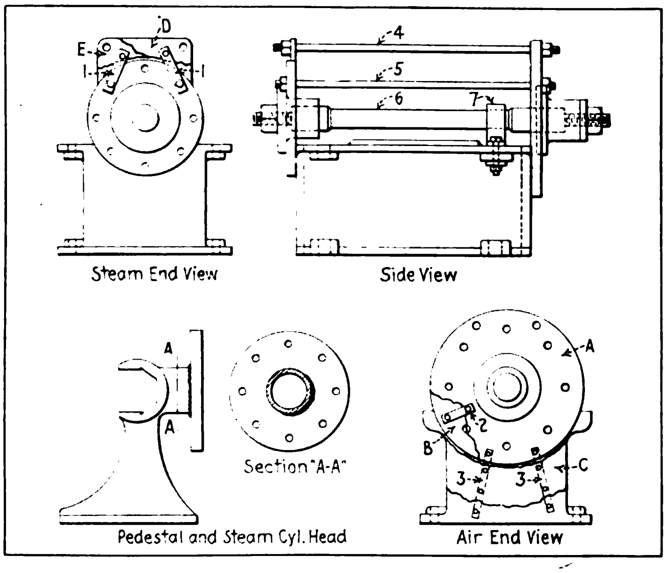
The shank is slotted endwise to receive the cutter. If it is desired to use different cutters in the same shank they may be positioned by the use of a centering dowel. The shank is turned to fit the tail stock spindle.

In using a forming tool of this kind, any variation in the alignment of the tail stock spindle with the live spindle will interfere with an equal distribution of the cut on the opposite ends of the tool. In placing the tool on the spindle it is well to set the cutter at an angle of about 45 deg. from the horizontal. In this way a slight side movement of the tail stock will furnish sufficient adjustment to center the tool and to overcome interference due to unequal spindle heights.

Oxy-acetylene welding of cast iron with brass

By V. T. Kropidlowski

A small, Ingersoll Sargent 10-in. by 10-in. by 10-in. straight line air compressor was broken almost beyond repairs, presumably due to a piston rod nut becoming loose and falling down in the clearance space. A number of parts were broken away entirely. The air cylinder head integral with the main frame was broken from the frame in two pieces as shown in the illustration at *A* and *B*. A piece *C* broke out from the end of the frame. Two pieces, *E* and *D*, were broken from the steam cylinder end of the same frame. The other steam cylinder head, integral with the pedestal, was cracked, and the center was knocked out of the other air cylinder head.



Method of holding broken pieces together when making a brass weld on cast iron

As it was imperative that the compressor should be repaired as quickly as possible, the broken parts were set up in their relative positions and held in place by bolting them with strips of iron such as designated by 1, 2 and 3 in the drawing. A mandrel, 6, was turned up in a lathe so that its ends fitted snugly in the stuffing boxes of the two cylinder heads. The ends of the mandrel were

threaded to take 1¼ in. nuts which held the heads rigidly in place against expansion and contraction during the process of welding. A strap, 7, with a prop underneath the mandrel was bolted to the frame near the air end to hold the mandrel parallel with the guides. In addition, rods 4 and 5 were used.

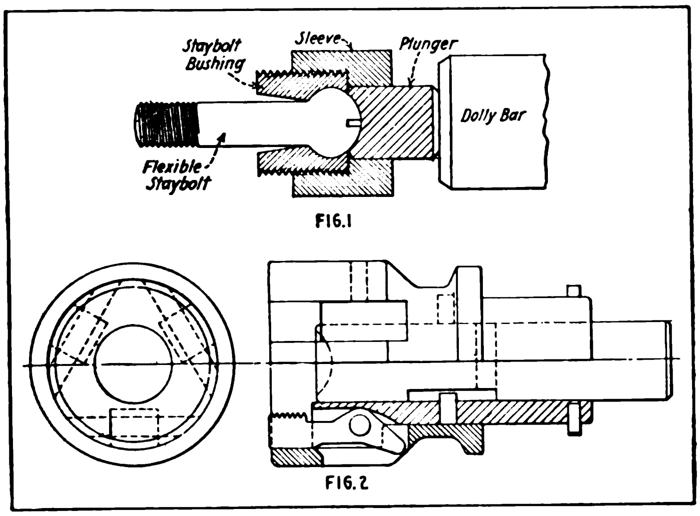
The oxy-acytelene method of welding was used, the welding material being brass. The compressor was of cast iron and if iron filler had been used the work would have had to be heated to redness, causing the casting to crack in the thinner sections at the time of cooling. In using brass as a filler, it was only necessary to heat the work slightly. There is a further factor of safety in using brass because it possesses a quality of flexibility which prevents cracks in the welds by reducing the strains set up by contraction when cooling. The casting was preheated by a gas burner, made from a ¾-in. pipe having ⅛-in. holes drilled in it similar to those in the hoops used in heating driving wheel tires.

When the job was done the casting was practically perfect in alinement. The air cylinder head *A*, was a scant 1/32 in. out vertically, which could have been easily dressed by hand, had it not been that it was readily faced in a 53-in. boring mill. The cylinder head integral with the pedestal was repaired by grooving around the crack and filling in with the acetylene torch using brass as a filler. The front air cylinder head which had the center knocked out was repaired by boring the center and threading it. A brass plug was then made, screwed in and welded in place.

The whole job cost $385 including a general overhauling which was not due to the accident. The job was completed within a month.

An improved dolly bar for holding on flexible staybolts

IT has long been known that the old method of holding on flexible staybolts for driving was slow and inefficient. A number of devices have been developed with a view to eliminating some of the drawbacks. Many of



Old and new devices for backing up flexible staybolts

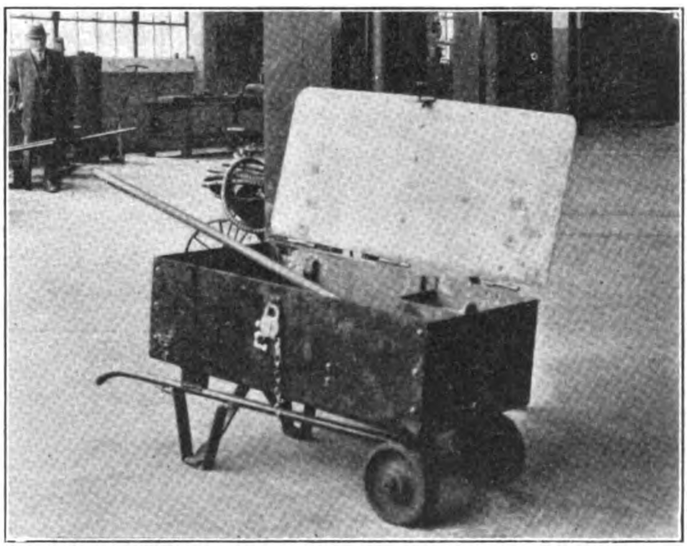
these have been found exceedingly helpful and in the list can be included the one described below which was developed at the Boston & Maine shops, Billerica, Mass. In the old method, as shown in Fig. 1, it is necessary to screw on the bushing sleeve for directing the plunger and for holding it in place. After the driving operation, time is required to remove it and fit it to another bushing. In driving a complete installation of bolts a great deal of valuable time is thus wasted in an operation that might be eliminated.

In the case of the new holder-on, as shown in Fig. 2, the operation can be done instantly. The opening sleeve which slides on the body of the device, when drawn back moves the cams actuating the three threaded gripping dogs and allows the holder-on to be easily slipped into place on the bushing. When the sleeve is moved back to its normal position these dogs grip the bushing threads securely and the operation can go forward. The plunger, which also moves in the body of the tool, is backed up by the dolly bar exactly as in the case of the old type holder-on.

To remove the device from the bushing after the driving operation is completed, it is only necessary to draw back on the control sleeve and the grips are instantly released. The device can of course be made of any practicable size—the one shown in Fig. 2 being designed to fit 1¾-in. flexible staybolt bushings having 12 threads per inch.

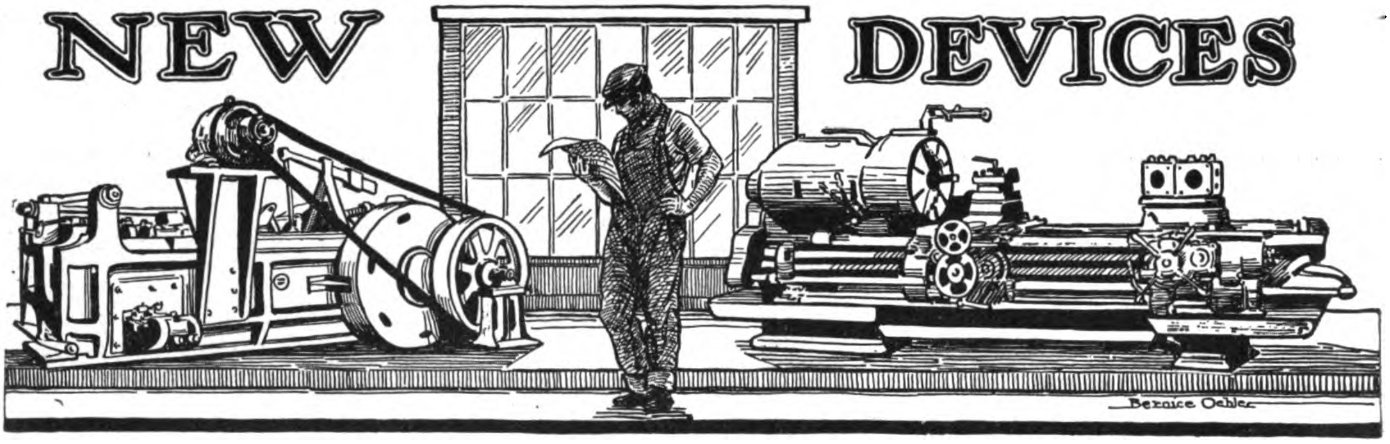
Portable tool box for the engine-house mechanic

PORTABLE tool boxes of the type shown in the illustration are used in the engine houses of the New York Central at its Selkirk terminal near Albany, New York. It is constructed of light sheet metal with a raising lid, which is provided with a hasp. Several small compartments for small tools are placed near the top so that the entire bottom of the box is left clear for the larger and heavier tools. The truck frame is constructed of two



A tool box which insures the enginehouse mechanic that his tools will be available when needed

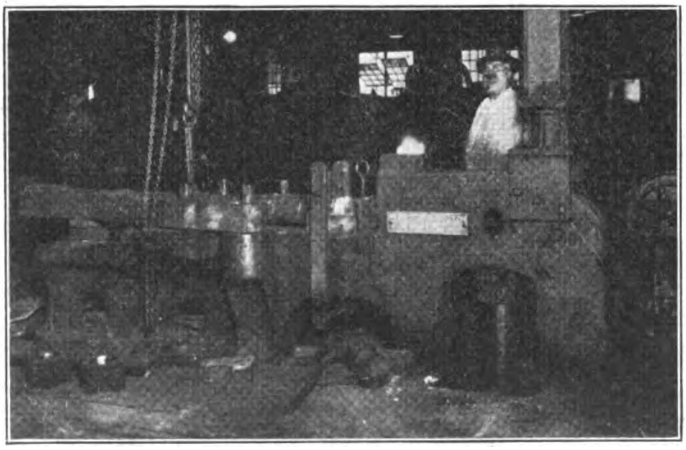
lengths of extra heavy 1-in. pipe, which are extended so as to form the handles, and 1¼-in. by ¼-in. rolled steel bar. It has proved to be very convenient in enginehouse work. Each mechanic has his own tool box which is identified by a number stenciled on the side. Individual padlocks may be used to lock the box when it is not in use and the mechanic is always assured of having a full complement of tools when needed.



Adjusting machine for the blacksmith shop

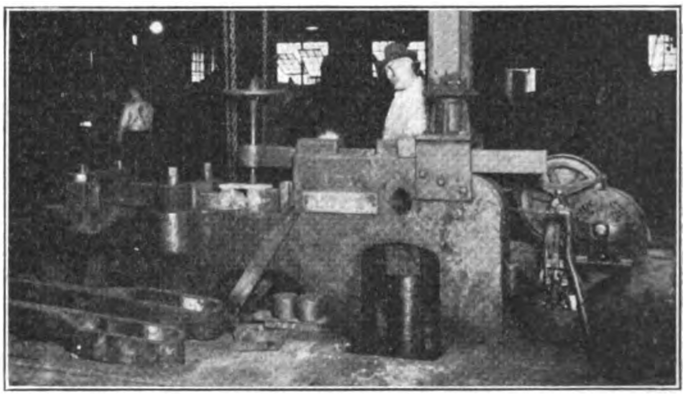
LENGTHENING, shortening and straightening by hand the various parts of the running and valve motion gear of a locomotive has always been considered a slow and inaccurate method of doing this work. The Walter Stock Adjusting Machine Company, Toledo, Ohio, have placed on the market an adjusting machine which has apparently solved this problem. It is made in four types all of which are identical in design, the only difference being the kind of power used for operating them. The type recommended for most railway shops is the one equipped with an electric motor driven hydraulic pump. This type is not dependent on any other equipment except electric power which is generally available and seldom out of service for any length of time. It is also always ready to operate without first starting up some other power unit such as the pumps on a hydraulic accumulator.

The construction of the machine is very simple, consisting of a frame, two toggle links, a ram, a filler, wedge and sliding block, four eccentric gripping cams, a clamping bar complete and two binding links. The two toggle links and the ram are joined together. The end of the rear link rests in a recess provided in the frame and is held in position with a pin. When the machine is in operation no pressure is exerted on any of the pins joining the links and the ram. Provision is made in the frame for the reception of the filler block, the sliding block, the two eccentric gripping cams and the wedge block.



Shortening an axle in the Walter Stock adjusting machine

When using the machine for shortening operations, the work can be held by either the forward or rear cams. If the rear cams are used, the sliding block is prevented from moving by placing the wedge block in one of the recesses of the frame provided for this purpose. When the pressure is first applied there may be some little slipping of the piece before the cams will grip it. Should the ram reach the end of its stroke before the operation is completed, the pressure should be released, and the space filled up with pieces of suitable dimensions, and the process repeated until the necessary adjustment is made. One end of the work is held by the cams, the other end is in contact with the ram, and the heated portion is between the two. As the pressure is applied the ram, pushing against the end of the work, upsets the part in the heated area.

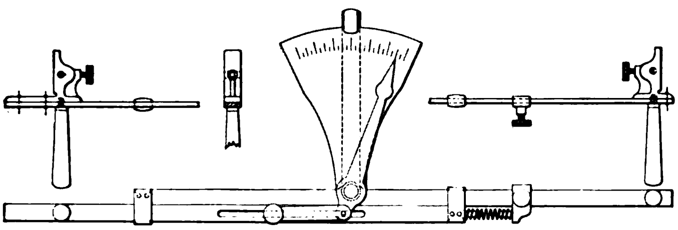


Motor driven adjusting machine closing up the jaws of a pedestal binder

When a piece is being lengthened it is held by two pairs of cams, with the heated portion between. The wedge block is removed and the space between the ram and the filler block as well as the space between the filler block and the sliding block is made up with false pieces. Pieces of scrap channel, side-rods or main rods cut in various lengths make the best filling-in pieces as they are light and more easily handled. Care should be taken to see that there is space allowed for the ram to extend to the limit of its stroke without touching the end of the part to be lengthened. It can be readily seen that with all space between the ram and the sliding block filled up, making a direct connection between these parts, any extension of the ram will move the sliding block. The part to be lengthened has one end held by the cams in the

frame, and the other end held by the cams in the sliding block with the heated portion between. As the sliding block is pushed, the piece will be stretched and lengthened.

For ordinary straightening jobs, it is necessary to place the wedge block behind the sliding block, to prevent it from moving. The work is placed cross-wise in the machine and the space between is made up so that the filler block will reach the work. As the ram moves forward the work is pressed against the sliding block and straightened. For straightening main and side rods it is advisable to have two heavy bars of steel about 4½ in. by 8½ in. by 40 in. machined all over, which are placed cross-wise in the machine. A badly bent and twisted main or side rod can be heated in a furnace and placed between these bars and made perfectly straight without a twist. There will be no hammer or die marks, and no thin spots.



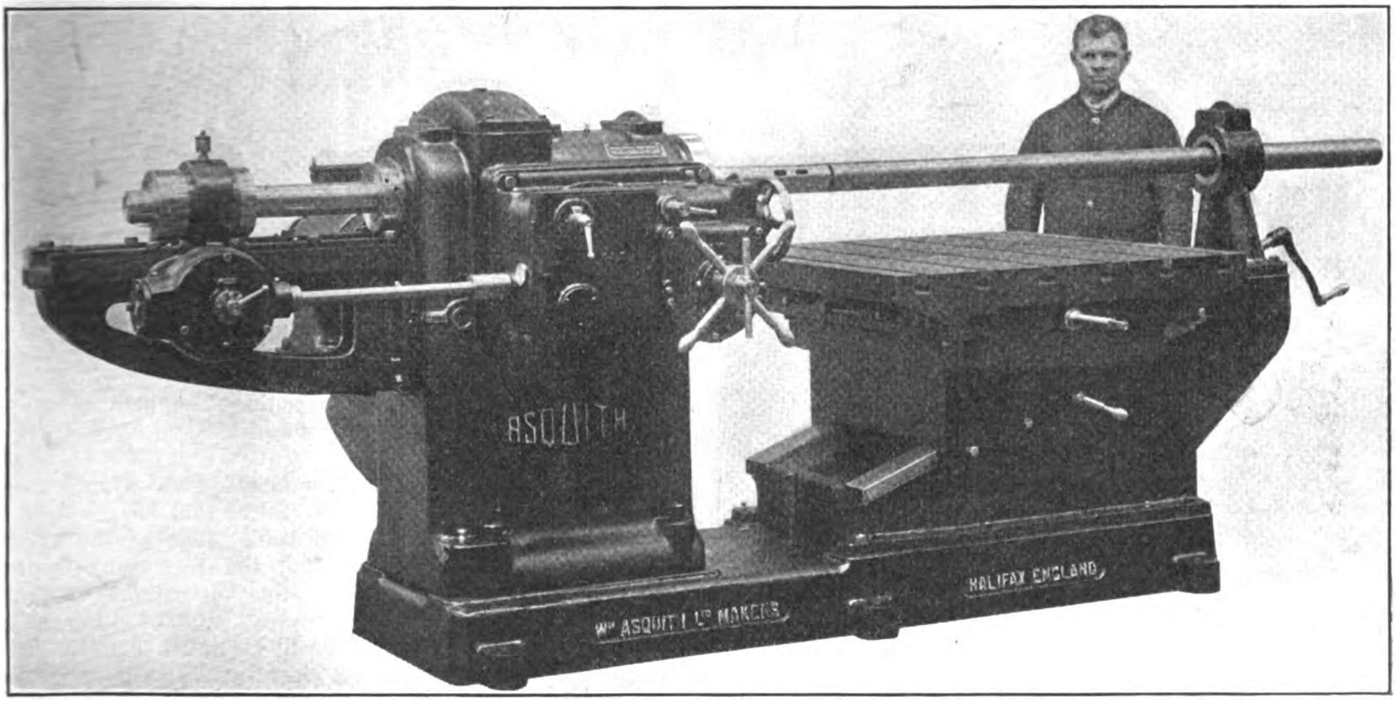
A gage with the machine which provides a means of making accurate adjustments when used on pedestal binders, side rods, drawbars, etc.

The gage with which each machine is furnished is an important feature of its equipment as it provides a means of making very accurate adjustments. When using the gage on pedestal binders, side rods, draw bars, etc., it is not necessary for the blacksmith to make the customary "hot and cold" marks. The lugs on each end of the gage are designed to slip into the jaws of the binder and a spring insures constant pressure against the binder jaws. As the machine pushes the jaws of the binder together it causes a hand to move across the dial, which is graduated at a six to one ratio which means that the graduations on the dial, which are 3/32 in., show that the work has been shortened 1/64 in.

Horizontal boring machine for journal box bearings

A SPECIALLY designed machine for the economical boring of journal box bearings has recently been developed by Wm. Asquith, Ltd., Halifax, Eng. The boxes are mounted on a strong work table which is provided with suitable T-slots. It is adjustable by hand motion on an angular slide, in order to enable the machine to handle boxes of varying heights. The boring bar, which carries the cutters, is cottered into the No. 5 Morse taper end of the spindle, and is removed through the steady rest after the cutters have been removed.

The spindle is of high carbon steel, accurately ground between dead centers, to be truly cylindrical. It is subject to no rotary wear, but simply slides in a large, accurately ground sleeve or socket. The spindle has a variable self-acting feed motion, fine hand feed motion, and a quick adjustment by hand, through rack and pinion. The sleeve which carries the spindle is of ample diameter for its purpose and has conical bearings at the front and rear. These bearings are accurately ground and are adjustable for wear, so as to maintain the correct alinement of the spindle with the steady rest bearing. The spindle feeds are obtained by means of a change feed



Asquith boring machine provided with a table adjustable on an angular slide by hand motion

gear box, the control to which is conveniently arranged.

The steady rest for the boring bar is firmly secured to the end of the angular table slide. The boring bars also are not subject to rotary wear, as they slide through a steady bushing and rotate in a large conical bushing in order to allow for taking up wear.

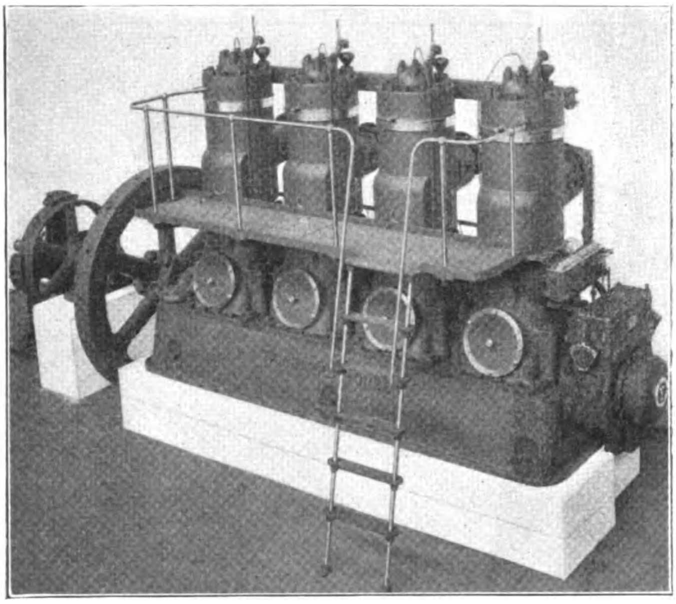
The machine is arranged for self-contained motor drive, the 5-hp. motor being mounted on a suitable bracket at the rear of the machine. Where d.c. current is available, the motor recommended is of the variable speed type with a speed of approximately 400 to 1,200 r.p.m.; where a.c. current only is available, the motor can be of the constant speed type, driving through a three speed gear box.

The complete machine is mounted on a strong foundation plate which is well ribbed to obviate deflection. The arrangement of the machine illustrated is such, that two boxes may be handled at one setting, being arranged in line with each other. It is possible, however, to handle four boxes at one setting by the adoption of the duplex form of the same type of machine. This duplex form is generally similar to the machine above described, except for the twin spindles, the two steady rests and the relatively larger dimensions. In this case the arrangement is such that each spindle deals with two boxes in line.

Changes in Fairbanks-Morse Diesel engine

ONE of the reasons for the increasing interest in the application of Diesel engines to a wide variety of railway power problems, such as the furnishing of power, light and pumping service, is in the increased dependability of these prime movers due to the constant mechanical improvement of the designs. Normal progress has indicated that an engine which would start without the aid of auxiliary ignition devices was an advantage and an improved design incorporating this feature has been brought out by Fairbanks, Morse & Co., Chicago.

No changes have been made in the general type of engine as the two cycle principle has been adhered to and the combustion scheme is based on solid injection of fuel as in the former Type "Y" engine. The engine operates under a compression of 500 lb. and the increased heat due to this compression fires the fuel without the aid of a torch when starting.

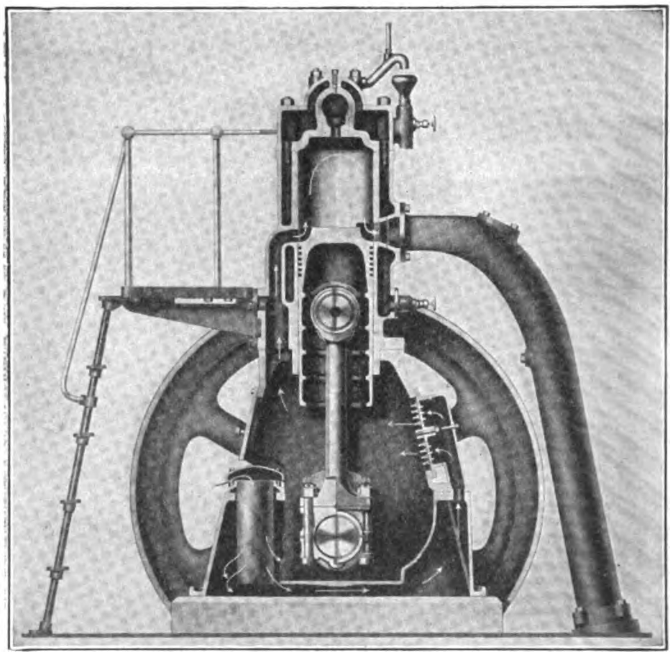


General view of new Fairbanks-Morse 200-hp. Type Y Diesel engine

Piping has been eliminated or enclosed, the control simplified, and what few adjustments there are, have been made more accessible without sacrificing simplicity of construction and reliability of operation.

At the present time the engine is built in ratings of 37½ and 50 hp. for the single cylinder unit; 75 and 100 hp. in two cylinders; 150 hp. in three cylinders; 200 hp. in four cylinders; and 300 hp. in six cylinders.

The primary consideration has been to develop an engine of the greatest reliability with low maintenance costs, maximum accessibility and one which is simple to operate. Fuel economy was also carefully considered, although no sacrifices were made in ultimate performance to secure the lowest possible test consumption of fuel.



Transverse section through the engine—The path of scavenging air indicated

The tests which have been conducted show a fuel consumption of 0.42 lb. of 18,000 B.t.u. fuel oil per brake horsepower-hour at full rated load. One of the characteristics of the engine is that the fuel consumption curve is practically a straight line on ratings varying from 75 to 120 per cent load.

From the sectional view it will be noted that the fuel is sprayed into a combustion chamber. This part of the design is quite similar to the former design except that certain improvements have been made in the shape of the chamber and in the neck leading to the cylinder. One advantage of this combustion chamber is that the air, on the compression stroke, rushes through the neck of the chamber and meets the atomized spray from the injection nozzle. The turbulence caused by this meeting of the air and fuel aids in preparing the fuel for complete combustion and also holds the charge in suspension. Owing to this thorough preparation of the fuel the final

burning is accomplished without an initial rise in pressure, resulting in true Diesel indicator cards. This system also eliminates the need for high injection pressure or a complicated injection nozzle of a type where the oil is sprayed through extremely fine holes.

When the piston reaches the end of its stroke, the temperature of the fuel charge in the auxiliary combustion chamber is raised to the ignition point and combustion begins. The hot gases then expand through the neck of the chamber and combustion is completed in the cylinder. In this way complete combustion is obtained as shown by the clear exhaust, from light load to over-load conditions. Moreover, the combustion does not cause any rise in pressure above the compression pressure, and the expansion is, therefore, similar to that of steam.

The fuel injection system is of the same general design as used in the former engine with the exception that the pumps are grouped on a pump deck and enclosed in a case which serves as the fuel oil reservoir. The change in the design has provided a more compact arrangement since it eliminates suction piping. By having the fuel pumps submerged the possibility of their becoming air bound is prevented. This fuel injection system, governor and the complete control of the engine centers in a unit mounted at the right end of the engine as shown in the general view.

Starting is accomplished by means of compressed air, the air being stored by an auxiliary power compressor in steel tanks of sufficient capacity for several starts. The pressure used for starting is approximately 200 lb.

Another important point in Diesel engine design is in the arrangements which are provided to eject the burned gases at the end of the expansion stroke. One of the improvements which has been made in the new design is that this scavenging air is transferred from the crank case to the cylinder through a passage outside the water jacket, thereby eliminating the necessity for air ports in the pistons and allowing the cylinder to be completely water-jacketed for its entire length. Reference to the sectional view will give an idea of how the scavenging air circulates through the base and to the cylinder. Before the opening of the air inlet or scavenging ports, which occurs shortly after the opening of the exhaust ports, the exhaust pressure drops to virtually atmospheric pressure. The air which has been compressed to a low pressure in the crank case, enters the cylinder when the scavenging ports are uncovered and is deflected by the piston to the upper portion of the cylinder, clearing out the remaining burned gases and charging the cylinder with fresh air. This scavenging air is supplied by the piston and crank case acting as a pump. On the upstroke of the piston, air is drawn through a screen and automatic air valve, into the crank case and is compressed on the working or downstroke.

Cooling water is introduced into the jacket of the head at both a top and bottom connection with the result that the whole jacket has a practically uniform temperature. The ridges of the cylinder ports are also cored for water passages and are thus kept at a uniform temperature. At the cooling water outlet, at the top of the cylinder head a spout is provided that discharges into a water header. This arrangement gives a visual check on the water circulation. Where the cooling water supply is limited and a re-circulation system is necessary, a closed connection from the cylinder head is used. In either case thermometers are provided for checking the cooling water temperature.

In the new design, several changes have been made in the lubricating system. The new system is entirely automatic, consisting of a double lubricating oil pump and an outside filter. The lubricating pump supplies oil to the mechanical lubricator, governor case, and main bearing wells. The governor case and main bearing wells are inter-connected and the oil is maintained at a constant level in them by the lubricating pump.

Used oil drains from the crank case to the oil sump and is pumped from this sump to the filter. The filter is entirely separate from the engine and is an efficient two-compartment type of large size, permitting the slow settling and filtering of the oil. Clean oil only is pumped from this filter back into the engine. One of the rather unique features of the lubricating system is the entire absence of oil caps, grease caps or oil holes. An oil can is unnecessary.

A welding flux suitable for iron, steel and bronze

WELDING flux plays an important part in making a homogeneous weld free from impurities. The chemists and metallurgists of the Chemical Treatment Company, New York, had these requirements in mind when they selected the ingredients of the welding flux known under the trade name of Welfex. The raw materials are passed through several progressive stages of manufacture for the purpose of securing a thoroughly uniform product.

The manufacturers claim for it several properties desirable for an effective welding flux. Its use gives a strong, soft and ductile weld or patch which can be machined, faced or drilled without chatter or change of speed and it can be readily used with all high temperature welding methods. The slag produced not only protects but absorbs the impurities from the exposed surface of the hot metal. It also prevents serious changes of silicon or carbon content in the metal. Welfex is a desulphurizer, the affinity of its slag being greater than that of the fused or molten metal.

When using the flux, one end of the welding rod is heated with the torch flame and when brought to a cherry red is dipped in the flux which will fuse and form a coating over the rod. The heat of the torch will then cause the flux to flow from the rod to the weld. The end of the rod and the welding area should be kept well covered with this coating of slag.

If the welding is to be done on heavy or massive work, additional flux should be provided by direct supply to the surface of the weld. Care should be exercised in having the flux form a fluid slag, of sufficient quantity to float over and completely cover the metal under fusion. This is essential, as the important service rendered by a fluxing slag is to dissolve metallic oxides, and shield the molten metal from oxidization.

The higher the temperature of the molten metal, the greater its affinity for oxygen. The quantity of flux to be added is regulated by the welding conditions. It should be used liberally rather than sparingly. This question must depend upon the judgment of the welder. If the flow of the welding metal is sluggish, additional flux will increase fluidity. Care should be used, however, to avoid excessive fluidity which would create a greater tendency for too rapid chilling of the welded metal.

Disk bearings for railway cars

THE Wollmar Engineering Corporation, New York is introducing a disk bearing for use on railway cars which is said to have all the advantages of ball and roller bearings with additional carrying capacity. The construction of these bearings, which are known as NKA disk bearings, is shown in Fig. 1. It will be noted in the drawing *Y* that the rolling surface of the disks has a radius of curvature larger than the diameter. The disks run in race grooves which are so dimensioned that practically the entire width of the roller comes in contact with the groove when the bearing is under load. This gives nearly a line contact between the rollers and groove which permits them to be self-guiding and allows a larger load carrying capacity.

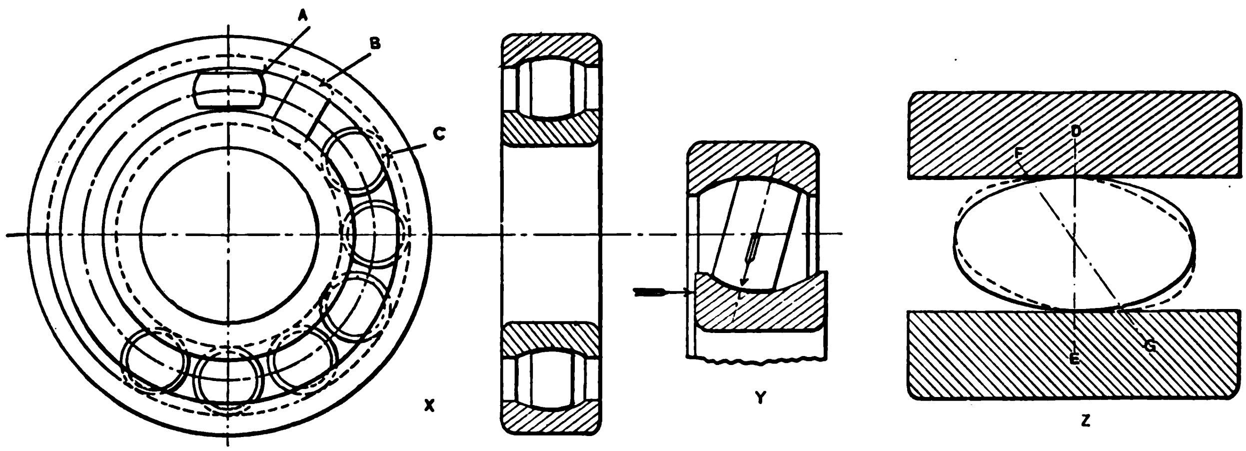


Fig. 1—Drawing showing the construction of the NKA disk bearing

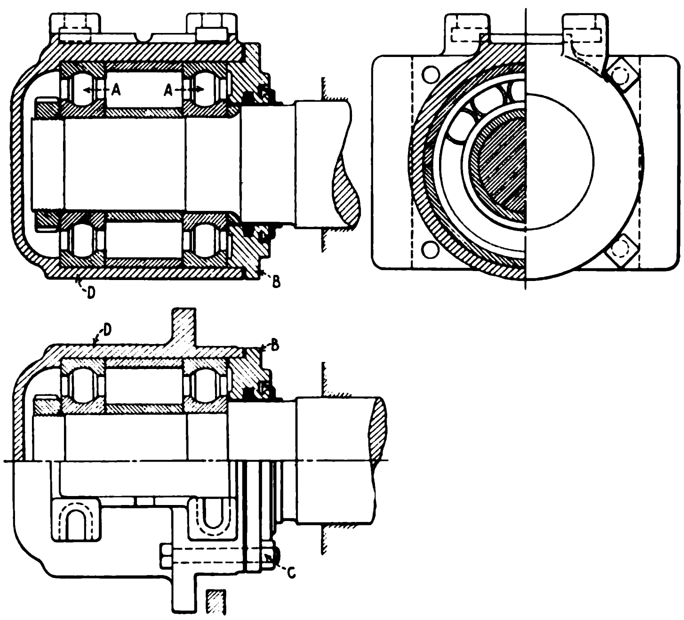
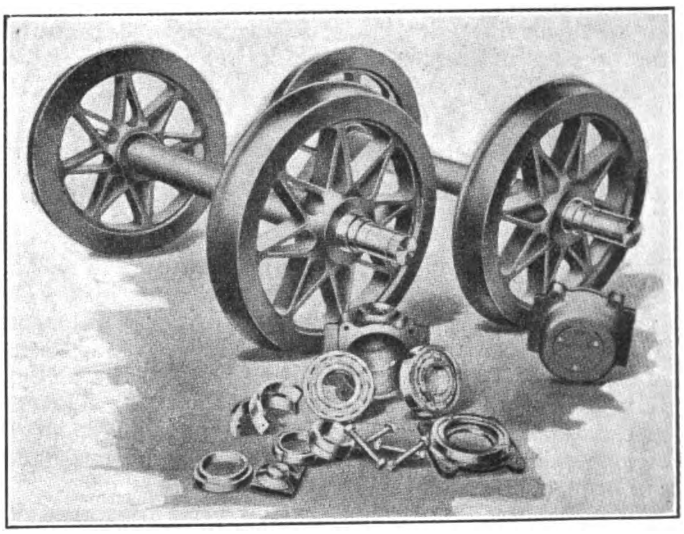


Fig. 2—Drawing showing the application of disk bearings to a railway car journal

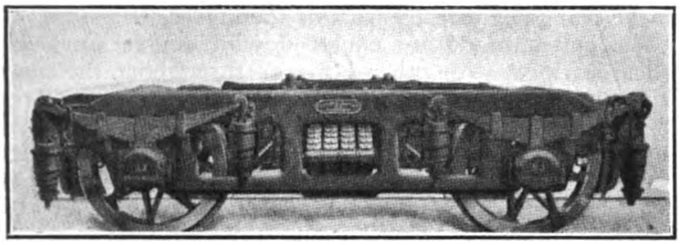
The self-guiding feature may be explained by referring to the drawing *Z* in Fig. 1. If we consider each disk to be cut from an ellipsoid of rotation and placed between two flat surfaces as shown at *Z*, the ellipsoid will roll on the smallest great circle and the contact surfaces will be symmetrical with the points *D* and *E*. If, for example, the disk should tend to turn to the right in the plane of the paper and the bearing continues to rotate, the ellipsoid will appear as shown on the dotted line with the points of contact moved to *F* and *G*. These points not being opposite to each other will produce a moment which will turn the disk to the left in the plane of the paper and back to its normal position. This action of the ellipsoid has been termed statical self-guiding. This statical self-guiding, however, is not sufficient to produce even running of the disks, because if the bearing is subject to radial pressure one-half of the disks will be without pressure and statical self-guiding cannot exist.

The moment of inertia about the normal axis of rotation is greater than the moment of inertia about any other axis due to the slight width. As a result, the disks are also termed to be dynamically self-guiding. It is well known that a free rotating body always tries to rotate about the axis which has the greatest moment of inertia.


Disk bearings disassembled from a European type railway car

If the disk bearing is subjected to an axial pressure only, the resultant force on each disk makes an angle with the axis of rotation of the bearing, and the disks take a

position as shown in drawing *Y* of Fig. 1 to react against the axial stresses. If a bearing is subjected to both axial and radial stresses, the various disks have different angles



European railway truck showing the application of disk bearings

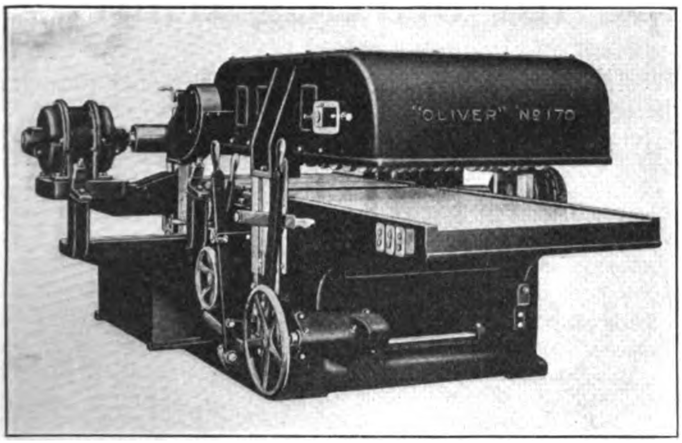
of reaction, the degree of which is decided by the resultant force which is exerted on them. The self-guiding properties of these disks have been verified by practical trials with bearings run without a cage. Their shape permits them to be inserted between the races shown at *A* in the drawing *X* of Fig. 1, twisted into position as shown at *B* and finally to the position *C*.

The NKA disk bearings have been used successfully on railway equipment of the Swedish State railways. The application of these disks to European railway equipment is shown in Fig. 2. Each journal has two bearings which are located at the ends of the journal. This design permits a distribution of the loading over a larger surface and it is also claimed that it can withstand shocks and temporary overloading to great advantage which is a much desired feature.

The work of development on European railway equipment was conducted by the manufacturers, Nordiska Kullager Aktiebolaget, Gothenburg, Sweden, from which the bearing derives its trade name.

Woodworking machines of unique design

The Oliver Machinery Company, Grand Rapids, Mich., has recently placed on the market under the trade name of "Straitoplane" a woodworking machine, the purpose of which is to do on one machine in one operation what heretofore has been done on two machines in two operations. The two machines referred



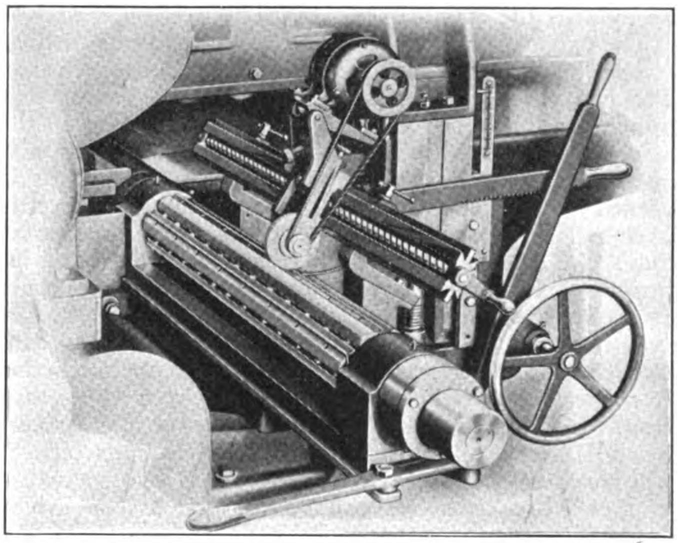
Front view of the Oliver "Straitoplane" showing the concentration of control levers

to are the hand planer and jointer, with some kind of a power feeding attachment and a surfacer. One of the outstanding features of the machine is its ability to take warped boards and finish them down to the desired dimensions, the finished product being smooth and straight.

The infeed table is a one-piece casting of arched ribbed construction. It has an actual feeding surface of 36¼ in. wide by 72 in. long. The end next to the bottom head is fitted with a steel plate. This table is supported by an inclined bed wedge which is a one-piece casting and rides on dovetailed gibbed ways for vertical adjustment by means of a ratchet lever on the left side of the machine, convenient to the operator. The frame of the outfeed table is a one-piece well ribbed casting with finished chilled plates bolted at the top to form an actual feeding surface of 36¼ in. wide by 41 in. long. In finished pockets at the sides of the outfeed table frame, bronze bearing boxes support the two lower feed rolls with adjustment for alinement. The outfeed table frame is supported by an inclined one-piece cast bed wedge in wide finished ways and is easily adjusted vertically to the cutting edge of the knives by means of a hand wheel conveniently located on the left, or operating side, of the machine.

The entire top section of the machine consists of two main castings securely bolted together. It is supported by four rectangular pillars fitted to the main frame in the slot gibbed ways and arranged to move vertically in unison by power, supplemented by a hand wheel micrometer set for the finished thickness desired. This top section carries the multiple contact conveyor, the top feed rolls, and the top cylinder unit with the chip breaker and pressure bar. The vertical movement is indicated by a scale and pointer within direct and convenient view of the operator.

The conveyor is of the wide chain mat type, having



View of the bottom head pulled out and resting on the self-contained bracket with the knife grinding attachment in use

cushion spring cam-dogs suspended from each link in such a manner as to assure a very sensitive, yet positive multiple contact feed. All essential parts of the conveyor are made of malleable steel. All parts are properly lubricated and positive take-up is provided to compensate for any possible elongation of the conveyor.

The main frame is a rigid casting with cored sides, girts, partitions and exhaust chute for the bottom head—

all cast in one piece. This frame supports, completely, all other parts of the machine on finished surfaces. The bottom is planed to give a solid continuous foundation support of 9½ in. wide by 72 in. long on both sides of the machine.

The top roll, ahead of the top cutter head, is sectional and is arranged with ample vertical movement for each section and also for the roll, as a whole, so that any desired top cut can be taken with ease. All other rolls are smooth, arranged for vertical adjustment to give proper alinement. The feed works are actuated through an initial belt, having a double idler take-up, controlled by a lever and ratchet stop, located at the left side of the operating end within easy reach of the operator, giving him easy control to throw the feed on or off, while the machine is running. Roller chains and sprockets are provided.

Both the top and bottom cutter heads are of 6-in. cutting diameter, fitted with six Tungsten thin knives. Provision is made for setting the knives easily and for joining and grinding the knives in the top cutter head when in place. The bottom cutter head is clamped in the frame with a tapered wedge going clear across the frame. This wedge is released by a convenient lever and the entire bottom head, with its bearings and housing yoke, are drawn out towards the left side of the machine, for setting and grinding the knives while resting on the sliding bracket which is fastened to the machine and always remains in place. The knives of the bottom head can be jointed in relation to the outfeed table, by raising the top section to the 6-in. limit and mounting the jointing head on the rear table directly back of the knives.

The cutter heads are equipped with double rows of roller bearings. All other bearings throughout the machine are of the bronze bushed type and all bearings are lubricated by the Alemite system. Complete control of the machine is located at the forward end of the left side so that the operator can, within easy reach of his natural position, stop and start the heads and feed and adjust vertically both tables as well as the entire top section.

Each machine, as regularly furnished, is so arranged as to be driven either by belted or by direct-coupled motors. The pulleys on the end of the heads also form the universal couplings so that by merely placing the motor brackets and motors each head can be direct driven. The power for the motor-driven machine is furnished by a 10-hp., 3,600 r.p.m. motor coupled to the bottom head; a 15-hp., 3,600 r.p.m. motor coupled to the top head, and a 7½-hp., two speed, 600 and 1,200 r.p.m. motor connected to the feed mechanism with a chain and sprockets. All three motors are provided with push-button automatic control, having the push buttons mounted on the front bed convenient to the operator. The two-speed motor has a high, low and stop push button.

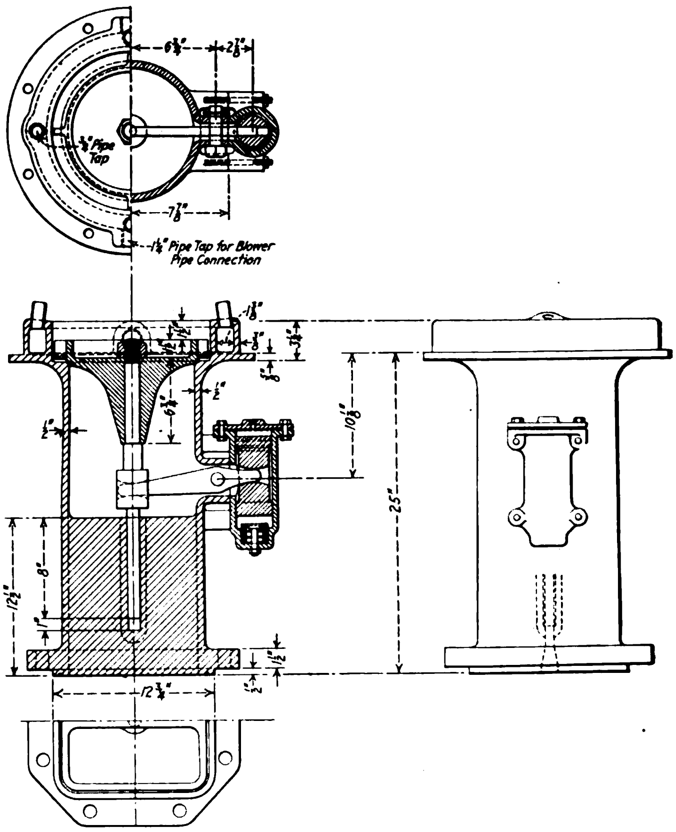
Locomotive exhaust pipe for braking trains

PATENTS have recently been granted to J. E. Osmer, Huron, S. D., on a locomotive exhaust pipe designed to operate in conjunction with a control valve, the function of which is to control a valve in the exhaust pipe which regulates the escape of exhaust steam from the cylinders and by means of the back pressure set up, retards the train.

The exhaust pipe tip, body and base are in one casting. A seat has been provided at the tip or nozzle for a valve. The body of the valve is designed with a contour that provides a variation of nozzle opening according to the height it is raised from the seat. The mechanism for raising the valve operates automatically when the throttle is opened and the valve reseats itself as soon as the throttle is closed. The closing of the exhaust nozzle as soon as the steam is shut off prevents cinders, and gases, injurious to lubrication, from being drawn into the steam chests and cylinders.

A feature of the device is that it can be used to control the speed of a train without the use of the air brake. A connection is made in the smokebox by a ½-in. pipe from the steam pipe to a steam cylinder on the exhaust pipe. Referring to the drawing of the exhaust pipe, it will be noted that the exhaust pipe valve is fitted with a stem which extends vertically down into a hole drilled in the dividing partition between the exhaust passages. A lever arm, operated by the piston in the small steam cylinder bolted to the exhaust pipe casting, engages the exhaust valve stem. A downward movement of the piston will raise the exhaust valve and vice versa. The piston is forced down by the steam which is carried to the top of the exhaust pipe cylinder by the ½-in. pipe. In order to raise the exhaust pipe valve the throttle must be opened.

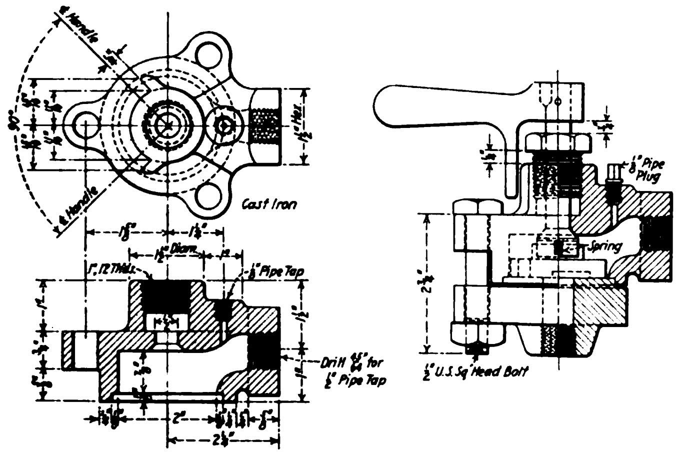
The exhaust pipe valve may be closed when the throttle is open by admitting steam at the bottom of the cylinder which forces the piston up and the valve down. Steam for this purpose is taken direct from the boiler through the control valve, a drawing of which is also shown. A ½-in. pipe is used to carry the steam from the control



An exhaust pipe which is closed by a valve when the locomotive is not working steam

valve, which is located in the cab near the air brake valve, to the exhaust pipe cylinder.

The closing of the exhaust pipe valve causes steam



The control valve

to be retained in the cylinders. This results in back pressure being built up, the amount of which may be controlled by the control valve and throttle. A gage is provided by which the engineman may know what pressure has been built up at the control valve and proper reduction may be made as deemed necessary. Braking is accomplished by means of the back pressure thus created. If it is desired to stop the locomotive, steam is admitted to the bottom of the exhaust pipe cylinder by means of the control valve, which holds the exhaust pipe valve in its seat. This confines the steam to the cylinders and builds up a high back pressure. In order to slacken speed, the throttle is opened wide which admits steam to the top of the exhaust cylinder and causes the exhaust pipe valve to rise, and the valve gear is placed in full travel position. The degree of the upward movement of the exhaust valve is regulated manually by the pressure on the bottom of the exhaust pipe cylinder piston. The engineman is thus able to control the amount of cylinder back pressure by adjustment of the throttle and control valve. The partial vacuum created within the cylinders when coasting with the throttle shut off tends slightly to bunch the train and at the same time to prevent pounding of the revolving and reciprocating parts.

Slipping while ascending a grade may be prevented by moving the handle of the control valve to "set" position, with the throttle left open.

Reversible placard holders for tank cars

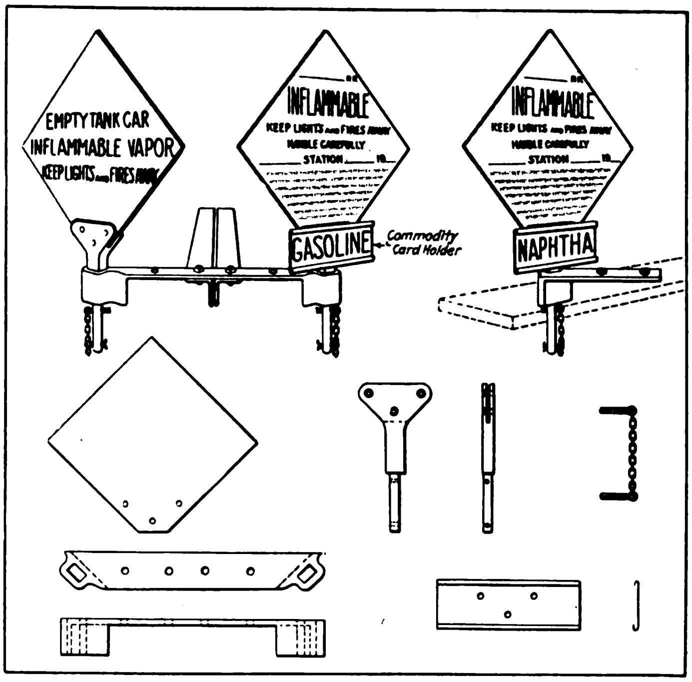
FOR the past several years the question of the application and removal of placards has been a live issue with the oil and other industries operating tank cars for transporting dangerous commodities. The device shown in the illustration, patented and marketed by E. A. Fall, 90 West St., New York, is designed to effect an improvement in existing conditions. The line drawing shows in detail the construction of the reversible placard holder and placard, assembled and knocked down. The general principles of the design have been approved by the Bureau of Explosives, and its application to tank cars is permissible under the rules and regulations set up and enforced by the Interstate Commerce Commission.

The base of the holder, shown in two forms, double and single, can be applied to the car in either form. Where the double base is used, it is applied diagonally across the steel sill brace at the corner of the car. This method immediately brings the two placards into proper location to serve the side and end running boards, insuring sufficient clearance of the placards from the running board to prevent the possible tripping and stumbling of trainmen. Where the single base is specified, the application of separate bases to the side and end running boards also insures sufficient clearance to avoid possible accident.

The upper part of the stem or shank has a rounded flare, which tends to strengthen the placard after the latter is placed in the slot in the head of the stem and securely riveted to prevent shifting. The center part of the shank is square in section and slightly tapered, while the bottom section is round, permitting free movement up and down. The lower section of the shank is provided with holes for the insertion of cotter pins whereby the placard is held in the desired position permanently or temporarily.

The base and shank of the holder are malleable iron, while the placard is 16 gage Armco iron, enamelled on both sides, which makes the holder and placard practical and durable for the class of service for which it is intended. The commodity car holder can, if desired, be quickly and easily applied at the time the placard is riveted to the shank.

The placard has printed on one side the information necessary when a tank car is loaded with an inflammable



Detail construction of reversible placard holder, assembled and knocked down

liquid and on the other the notice required when the car has been emptied of its contents. Thus, one placard serves the car when loaded or empty merely by reversing it in its holder to bring to the front whichever side is required.

Circular cross-cut and rip saw filer

WOOD-CUTTING saws of various types are used extensively by the railroads and in order to obtain maximum efficiency from them the saw blades must be frequently sharpened in the proper manner. The Wardwell Manufacturing Company, Cleveland, Ohio, has recently placed on the market a combination cross-cut and rip circular saw filing machine. It has a range of capacity for sharpening all cross-cut and rip circular saws up to 18 in. diameter, with teeth from the smallest up to ½ in. from point to point at a speed of 65 teeth per minute.

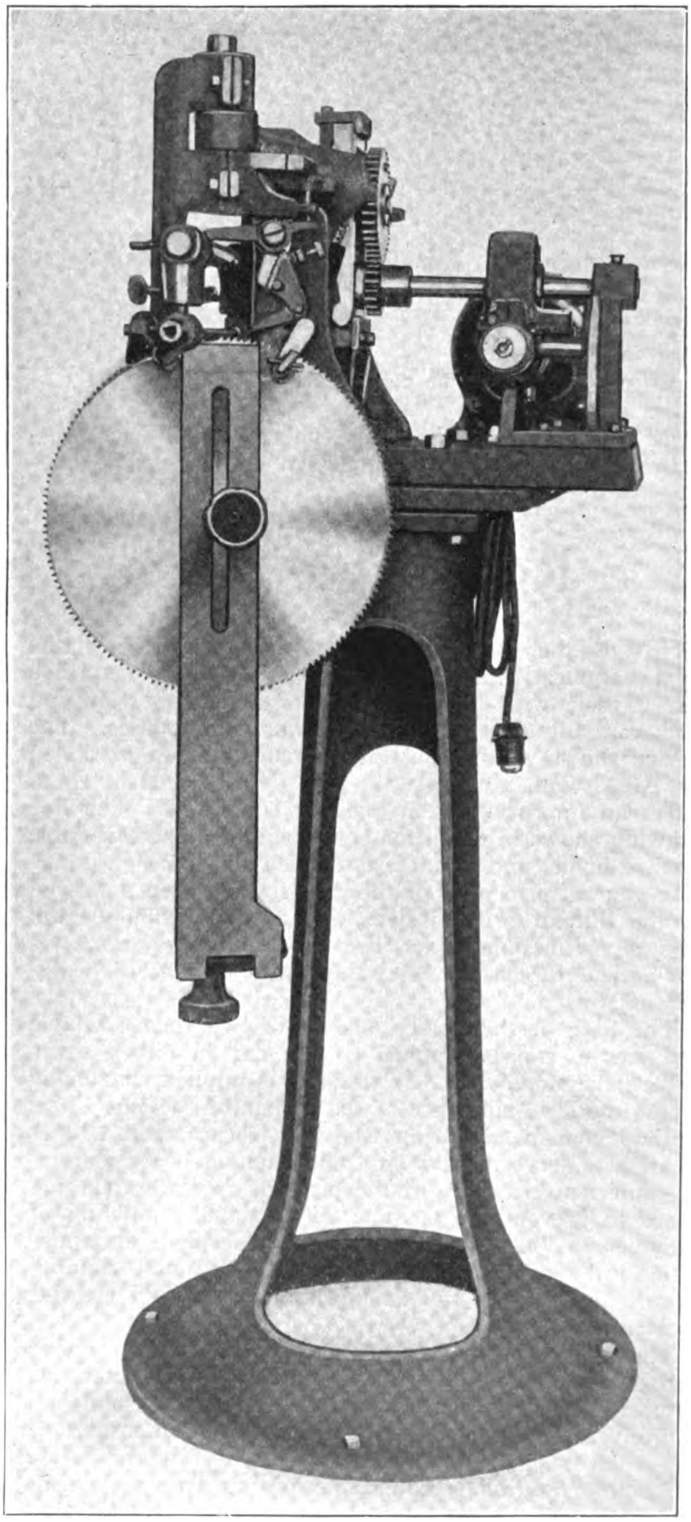
The frames, pulleys and the horizontal slide that carries the file are made of gray cast iron. The cam shaft bracket is babbitted and the swivel head bearings are fitted with radial adjustments. The vise contacts and all parts subjected to wear are made of steel. The filing arm works between heavy adjustable bronze gibs which insures accuracy.

The machine is automatic after starting. The bevelling of the cross-cut saw teeth is secured by the automatic swivelling of the vise frame holding the saw. The amount or degree of bevel can be regulated and adjustments can be made for saws of varying gages. The machine can handle three different degrees of bevels. Through the elliptical movement of the filing arm any hook of tooth can be filed and all teeth can be sharpened without a particle of a burr.

The operation of the machine is simple. To the main drive shaft is connected a cam which raises the slide frame at a slight angle out of the vertical, which gives an oblique movement to the file the same as in hand filing, and allows the file to enter and leave any hook of tooth. On the point of the cam is a hardened steel roller which operates the horizontal slide filing arm. Two adjustments cover the movement of the pawl lever attached to the swivelling head frame and rocked by a riding rod on the filing arm. One of these adjustments covers the length of stroke and the other the amount of cut removed from the face of the tooth. One elevating screw raises or lowers the saw at the point of filing. The saw is gripped rigid during the filing stroke, then is automatically released as the filing arm raises, thus paralleling the movement of hand filing.

The swivelling movement of the head and saw vise is secured through a two to one gear connection from the main drive shaft. The saw is turned alternately right and left to an amount depending on the number of degrees of bevel to be given the teeth. The teeth of crosscut saws are thus consecutively sharpened with alternate bevels through the swivelling of the saw between each stroke of the file. Rip saws, the teeth of which do not require bevelling, are filed straight across by slipping the gears out of mesh and tightening the vise head in position at right angles to the file. The saw vise is easily removed for cleaning when necessary. The saws are fed through a pawl movement. When this pawl or feed finger is allowed to feed one tooth behind the one that is being filed, the teeth are all jointed.

The machine shown in the illustration is mounted on a pedestal and is direct connected to a motor. The base is a casting, which supports both the motor and the machine. One cast iron bracket supports the end of the main drive shaft as well as the end of the shaft extending from the motor. A hardened cut worm and gear are used which run in an oil bath. A universal, flexible coupling permits of easily removing the motor as well as relieving the pressure on the armature. Each machine is furnished with a motor fully equipped with insulated wire and a plug for attaching to a lamp socket by a snap swivel. All the motors are self starting and driven from a lamp socket of light current.



Wardwell saw filer with direct connected motor, mounted on a pedestal

The speed of the motor is 70 r.p.m. If belt driven the pulley is 10 in. by 1¾ in. The machine requires a bench space of 12 in. by 10 in. The weight of the machine without the pedestal is 85 lb.

Universal cutter and tool grinder

A UNIVERSAL cutter and tool grinder suitable for the toolroom has recently been placed on the market by the Wilmarth & Morman Company, Grand Rapids, Mich. It can be furnished with either a belt or motor drive. The belt drive can be converted into a motor drive at any time by replacing the main head. In eliminating the belt drive the head or table can be swung 360 deg. Two motors are furnished, a ½-hp. motor on the main head and a ⅛-hp motor on the head stock.

Motor driven universal cutter and tool grinder

The machine contains several improved features. The longitudinal feed may be controlled from the front or rear of the machine. The micrometer adjustment of the table can be put in use at any angle of the table. The knee is supported by the full circumference of the column which is fully protected from dust and grit. The saddle is also constructed so as to protect all working parts underneath from dust and grit. All movements on the machine are provided with taper gibs or adjustable take-up nuts. All the attachments which go with the machine are interchangeable with the No. 1 universal grinder manufactured by this company.

The following are some of the specifications of the machine: The longitudinal, vertical and transverse movements of the table are 16 in., 8 in., and 8 in. respectively. The centers will swing work up to 10⅜ in. in diameter by 20 in. long. The internal grinder attachment has a speed from 9,000 to 18,000 r.p.m. and will grind from 9/16 in. diameter up, 3 in. deep and from 1¼ in. diameter up, 5 in. deep. The universal attachment will swing cutters 16 in. in diameter over the table and 24 in. in diameter over the sub-table. The gear cutter attachment will cut 120 pitch to one pitch in gear blanks ranging from 1¾ in. to 8½ in. in diameter. The steady rest and chuck have a capacity of 2½ in. and 4 in., respectively. The tilting and swivel vise base opens 2⅜ in. and the jaws may be temporarily removed, increasing the opening ¾ in. The table has a working surface of 5½ in. by 32 in. The spindle speeds are 3,000 and 6,000 r.p.m.

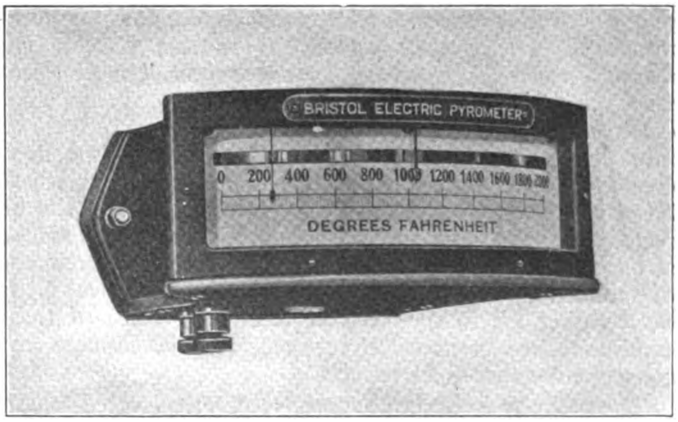
High resistance indicating pyrometer

THE Bristol Company, Waterbury, Conn., has recently placed on the market a new model high resistance indicating pyrometer. It has a scale seven inches wide which permits the pyrometer to be easily read at a considerable distance from it. As a further aid to easy visibility, a combination pointer is provided, having a broad section for distance reading and a knife blade section for accurate close-up work. In addition to these features, the scale is also provided with a mirror, which eliminates any possible errors in reading due to parallax.

A high resistance Weston millivoltmeter is used for the measuring element which is equipped with an accurately balanced moving coil and pointer. It has a resistance of 15 to 20 ohms per millivolt. An automatic cold-end compensator is provided to give an accurate scale reading without the necessity of making allowance for a correction.

There is an unavoidable variation of temperature in the pyrometer itself which influences the correctness of the reading. This factor has been taken into consideration when designing the instrument so that any effect of temperature changes on the accuracy of the pyrometer is minimized.

The case is made of cast aluminum and is of dust-proof construction. It is arranged for wall or switchboard mounting, having a demountable base for separately bolting to the wall and supporting the instrument. A small adjusting screw on the outside of the case provides an easy means of zero adjustment. A knob on the top of the case makes it possible to set the normal index spotter for the temperature desired for each individual piece of work.

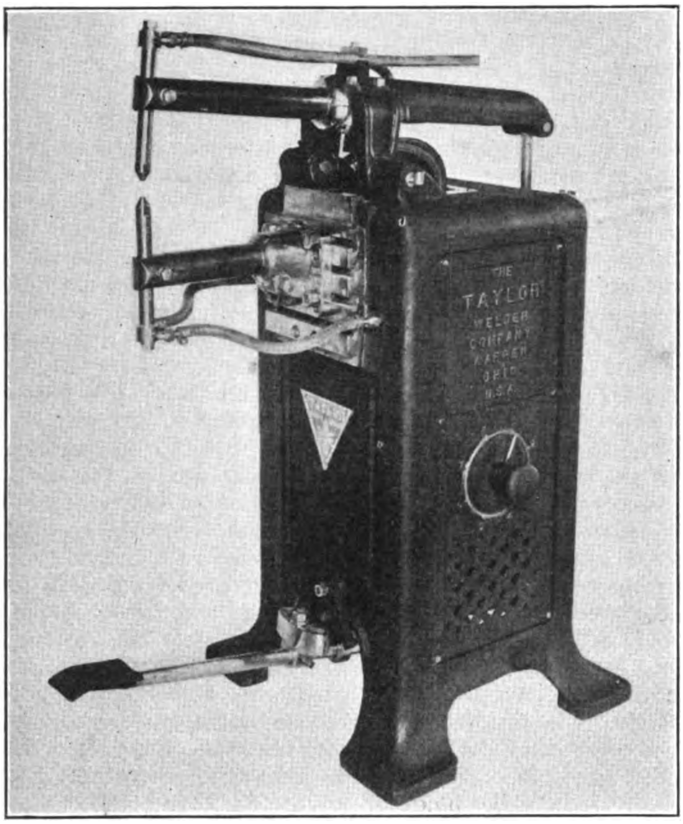


Bristol high resistance indicating pyrometer with an exceptional range of visibility

The pyrometer can be furnished for all ranges up to 5,000 deg. F.

Water cooled spot welding machine

ONE of the type N spot welding machines recently placed on the market by the Taylor Welder Company, Warren, Ohio, is shown in the illustration.



Taylor spot welder provided with adjustable horns

This machine is built in three sizes for welding work ranging from No. 30 gage material to two plates 3/16 in. thick. The overhang is from 6 in. to 30 in. The upper horn is adjustable in and out to permit the use of gooseneck welding points with one of the regular welding points, and both horns can be revolved in either direction to allow welding in corners and otherwise inaccessible places. The lower horn is adjustable up and down and sidewise in either direction.

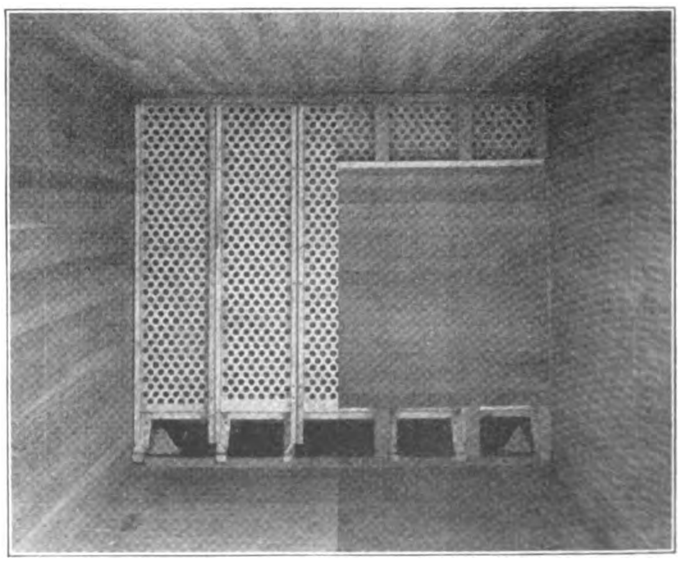
The smallest machine is equipped with a 10-kw. transformer, and the intermediate with a 15-kw. transformer. There is an eight-step self contained regulator for adjusting the current to take care of the lightest work up to the capacity of the machine. The switch is of an automatic and non-automatic type so designed that it cannot close until the electrodes have made proper contact with the work. No adjustments are required for different thicknesses of work or for wear of the electrodes. The switch is changed from an automatic to a non-automatic trip by operating a lever. The automatic trip is desirable for welding work that is buckled and does not fit together properly, as it permits a positive pressure to be applied to the weld after the current has been turned off, and thus prevents the weld from separating while in the molten state. It is desirable to set the switch in the non-trip position in welding wire and clean sheets, and also in operations where greater speed is wanted. The pressure on the electrodes is controlled by means of a handwheel.

In addition to the water circulation in the electrodes, the transformer is water cooled. The machine may be furnished with a quick change gear box and either a belt or motor drive. The foot-treadle is adjustable in or out and may also be swiveled to suit the convenience of the operator. The travel of the upper electrode and the foot-treadle can be varied for different thicknesses of work by means of a lever which is located on the front of the machine.

All-metal bulkhead and ice grate

THE Equipco all metal bulkhead and ice grate illustrated has been designed and constructed by the Equipment Specialties Company, Chicago, to give a strong, pilfer-proof ice compartment for refrigerator cars. The usual wooden ice grates are easily cut through with a saw or axe, or the bulkhead netting cut with clippers. Tools for this purpose are readily concealed about the person, and the thief merely drops down into the ice compartment and cuts through to the merchandise; no seals need be disturbed and he works where he cannot be seen. Besides preventing pilferage, the all metal bulkhead and ice grate is designed to provide a strong construction which will eliminate the breakage of bulkhead posts, due to shifting loads in the car body or wedging ice in the ice compartment. Both of these conditions are responsible for considerable damage and consequent expense in repairs.

The Equipco design consists of perforated metal sections which, when in place form a strong partition across the car. The posts are formed as integral parts of these sections. The tops of the sections are bolted directly to the ceiling and header, while the fastening at the floor is by means of post shoe castings secured to the floor rail. This gives the equivalent of an all steel end for refrigerator cars, located where it will afford the maximum protection, namely at the bulkhead and not at the car end as in the case of box cars. The actual trouble from shifting loads in refrigerator cars comes at the



Equipco all-metal bulkhead in refrigerator car—The left half of the wooden face of the bulkhead is cut away to show the perforated metal sections

bulkheads and not at the end walls of the refrigerator cars.

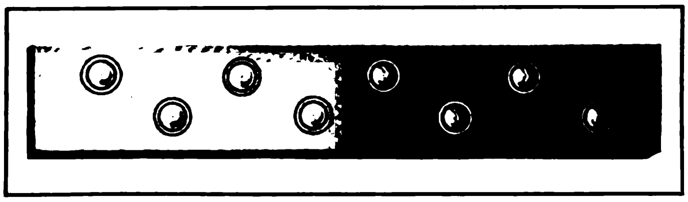
The so-called basket bunker generally used is maintained, but the piece of netting at the bulkhead is unnecessary as the perforated sections answer the same purpose. The sections are bolted to each other, and securely fastened to the side walls of the car.

The substantial pressed steel grates are individual bars, not made in sections as is the case with wooden grates. The grate bars are carried between the flanges of channel-shaped carriers, and they are locked in place by a key grate bar at the center. The fastening or lock for the key grate is accessible only from the inside of the car proper, and not from the ice compartment. Thus, unless this key grate is removed, none of the other bars can be disturbed. One of the illustrations shows a close-up view of the pressed steel grate bars and indicates how they are carried in the channels.

Further advantages claimed for the Equipco metal bulkhead and ice grate are minimum maintenance expense, easy application, and conformance to existing standards of ice capacity and distance between bulkhead faces. This equipment is already in service on three important refrigerator lines.

Ball parallels for use in drilling heavy work

BALL parallels for use in connection with the drilling or counterboring of heavy fixtures, jigs, dies and other heavy work are shown in the accompanying illustration. They are intended to permit the drill or counter bore to pull the work in line with the spindle.



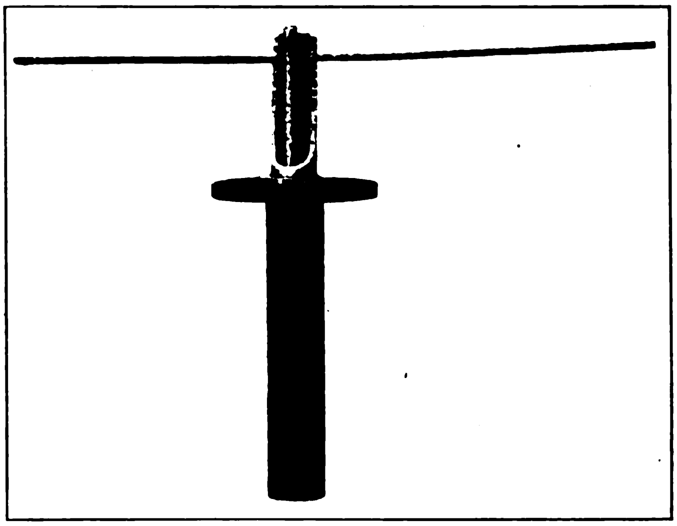
Ball parallels used in drilling heavy work

The manufacturer, the J. F. Smith Tool Company, Dayton, Ohio, is producing two sizes, one of which is 1 in. wide and 6 in. long and fitted with ¼-in. balls while the largest size is 1 in. by 7 in. and equipped with balls ⅜ in. in diameter.

Electrode holder for metallic arc welding

A NEW type of welding electrode holder, marketed by the General Electric Company, Schenectady, N. Y., allows welding operators to make a quick change from a burnt stub to a new electrode. The operator needs only to strike the stub end of the old electrode, causing it to drop out after which the new wire can be inserted without unnecessary effort.

The holder consists of a punched fibre tube with a tinned brass plug inserted in the end. A steel spring rod holds the electrode in place against one of a number of different sized notches provided for this purpose. The welding cable running to the source of power is soldered to the other end of the holder. The fibre tube and guard can be removed by loosening a single screw. The construction of this holder is such that the contact of



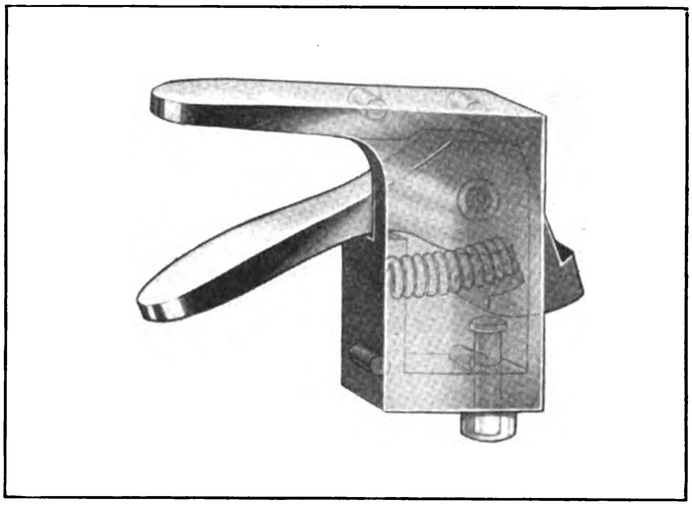
Electrode holder which permits a quick change of electrodes

the electrode is not weakened by heat, since it does not depend upon any heat-affected spring.

Combined sash lock and window opener

THE National Lock Washer Company, Newark, New Jersey, has placed on the market a unique device in the form of a combined sash lock and window opener.

From the illustration it will be noted that when the slightest pressure is imparted to the lower lever of the



Sash lock designed to open sticking car windows

sash lock, the lifting force is multiplied many times by a cam which pushes down a small plunger extending through the bottom of the sash lock case. This force is sufficient to start sticking or immovable windows. When the window has been so released it can be adjusted to any desired height in the normal way.

It is through the employment of a dowel and bolt construction that such a device is made possible. The phantom illustrations shown will give a clear idea of the construction of this device.

General News

Many aspects of the railroad problem were discussed briefly and pointedly in a bulletin distributed by the Atchison, Topeka and Santa Fe under the authority of W. B. Storey, president, as a New Year Greeting on January 1. The necessity for constant heavy expenditures for new equipment and facilities, the legislative situation in Congress, the employees and their wages, freight rates, increases in transportation costs, competition with motor trucks, and the necessity of efficiency in the use of equipment were discussed in the bulletin.

Soo line offers prizes for shop ideas

Six prizes totalling $100 have been offered by the Minneapolis, St. Paul & Sault Ste. Marie to its employees in the car and locomotive departments for the best ideas for improving and facilitating shop practice. First prizes of $25, second prizes of $15 and third prizes of $10 are offered to the employees of each department. The competition will close on April 1.

Southern Pacific lines offer safety prizes

Foreman of the maintenance of way, mechanical, stores and station service departments of the Southern Pacific, Texas and Louisiana lines, are eligible for prizes of $15 each, to be paid shortly after December 31, 1925, if they can complete the year without a single reportable accident in their gangs. The $15 prize is the minimum and applies to foremen in charge of gangs working 20,000 man-hours or less during the year. The prize is increased at the rate of $15 for each 40,000 additional man-hours worked without reportable accidents up to a maximum prize of $105, except that, regardless of the size of the gang, foremen having three or more reportable accidents are not eligible for any prize. This competition is open to all foremen of the maintenance, mechanical and stores departments whose gangs work more than 10,000 man-hours during the year, and foremen of warehouse and transfer gangs working 20,000 or more man-hours during the year.

Status of automatic train control orders

In addition to the railroads that have been allowed by the Interstate Commerce Commission an extension of time in which to complete their installation of automatic train control on a division as required by the commission's order of June 13, 1922, there are several roads that have not filed any petition for an extension of time, or whose petitions, if filed, have not yet been acted upon by the commission. Most of the roads have been granted extensions and four have been denied, but in addition the installations on the Atchison, Topeka & Santa Fe; Chesapeake & Ohio; Chicago & Eastern Illinois; Chicago, Rock Island & Pacific; Philadelphia & Reading, and Southern Pacific are regarded as completed, or practically so. The Atlantic Coast Line has filed a petition for an extension on which the commission has not yet announced its decision, and it is understood that the Chicago, Milwaukee & St. Paul; Long Island, Pennsylvania, and West Jersey & Seashore have not yet filed petitions for an extension.

The Chicago, Burlington & Quincy has petitioned the commission for an extension of time to June 30, 1925, to complete the automatic train control installation. The company has let a contract to the Sprague Safety Control & Signal Company which guarantees compliance with the commission's specifications.

The Richmond, Fredericksburg & Potomac, one of the four roads to which the Interstate Commerce Commission refused an extension of time beyond January 1 in which to complete the installation of automatic train control, has filed a petition with the commission for a rehearing. The petition says the road is a "bridge line" transferring the passenger and freight trains of six large roads and that therefore it is especially important that it have the best device obtainable. After the commission had authorized preliminary tests of 20-mile sections the company had contracted with the Union Switch & Signal Company on August 11 for an installation between Richmond and Doswell, Va., 20 miles, and expects to be in a position to request a preliminary inspection by the commission some time in March.

The Interstate Commerce Commission has granted the petition of the Richmond, Fredericksburg & Potomac for an extension of time in which to complete its automatic train control installation to July 1, although this was one of the four roads for which the commission had previously denied an extension. The commission has also granted an extension to July 1 on petitions filed since the first of the year by the Pennsylvania; the Pittsburgh, Cincinnati, Chicago & St. Louis; the West Jersey & Seashore and the Atlantic Coast Line.

The Central of New Jersey, which was also one of the four roads denied an extension of time, has filed a new petition asking for a reconsideration and for an extension to September 1.

New York Central to give lectures on railroading

Following a request from members of the New York Central Athletic Association at Rochester, N. Y., the New York Central has arranged for a course of lectures to be given on the science of railroading. The lectures will be in the nature of university extension courses and members will be invited to prepare papers on the subjects treated in each lecture for which prizes will be awarded. The lectures will be given on the last Thursday of each month.

On January 29 T. W. Evans, assistant vice-president of operation, lectured on the part played by the railroads in the economic life of the nation. On February 26 F. E. Williamson, general superintendent of the New York terminal district, will speak on transportation and supervision. On March 26 W. C. Wishart, controller, will speak on railroad financing and accounting. On April 30 G. W. Kittredge, chief engineer, will speak on the principles of railroad location and construction. The course will include lectures on locomotive and car design by F. H. Hardin, chief engineer of motive power and rolling stock; the maintenance of locomotives and cars by R. M. Brown, assistant superintendent of motive power; and on the maintenance of tracks, bridges and buildings, by J. V. Neubert, engineer maintenance of way. In addition, the faculty of Rochester University will participate.

Court news

FUSIBLE PLUGS NOT ESSENTIAL IN CROWN SHEETS UNDER BOILER INSPECTION ACT.—Action was brought in the federal district court for the northern district of Ohio, under the Federal Employers' Liability Act and the Boiler Inspection Act, against the Baltimore & Ohio for damages for the death of an engineman killed by an explosion of the boiler of his engine.

The trial court submitted for decision of the jury two issues: whether the explosion was caused in whole or in part by an unsafe and insufficient condition permitted by defendant in and about the crown sheet of the boiler; and, whether defendant's failure to have a fusible plug in the crown sheet violated Sec. 2 of the Boiler Inspection Act. Verdict and judgment were rendered for plaintiff. The Circuit Court of Appeals, Sixth Circuit, affirmed the judgment (288 Fed. 321), and the case was taken to the United States Supreme Court on certiorari.

1. The railroad asserted that Sec. 2 of the Boiler Inspection Act prescribes no definite or ascertainable standard of duty. The United States Supreme Court holds that the requirement of the statute "is as definite and certain as is the common law rule; and to hold that the duty imposed cannot be ascertained would be to declare that the common law rule which is ordinarily applied in personal injury actions brought by employees against employers is too indefinite to be enforced or complied with." This contention was therefore held to be without merit.

2. The railroad averred absence of evidence that the explosion

resulted from any defective or dangerous condition of the crown sheet.

There was no fusible plug in the crown sheet. The Supreme Court holds that Rule 25, approved by the Interstate Commerce Commission, does not purport to require fusible plugs to be used. It was shown that the boiler had seven broken staybolts, and that they had been broken some time before the day the explosion occurred; and it is held that use of the boiler in that condition violated Rule 25; but it was not shown what caused these to break. All persons on the engine—engineer, fireman and brakeman—were killed. The train had stopped for water at Foster's Tower, about three miles from the place of the explosion. A brakeman employed on another train, then at that station, testified that he went into the cab of this engine, and that, while there, he observed that water and steam were escaping from the boiler into the firebox; that he heard the sizzling of the water upon the fire; that, when he opened the firebox door, steam gushed out; that the fire was dead; that the steam gage showed 160 lb. pressure, and that water was being put into the boiler by the two injectors. The location of the broken staybolts in relation to the place of rupture was shown to be such that the explosion was not caused by them. But the court agreed with the Circuit Court of Appeals that, under Sec. 2 of the statute, there was sufficient evidence to sustain the verdict, wholly apart from the broken staybolts. The railroad was liable if its breach of duty contributed to cause the death. The credibility and weight of the brakeman's testimony as to the condition of the boiler at Foster were for the jury; and if the boiler was in the condition he described, it was held that it would not be unreasonable to conclude that a breach of duty of the railroad caused or contributed to cause the explosion. It did not conclusively appear that the failure of deceased properly to operate the engine was the sole cause of the explosion, so the evidence made a case for the jury.

3. The Supreme Court holds that the trial court erred in instructing the jury that the defendant was bound to avail itself of "the best mechanical contrivances and inventions in known practical use which are or would be effective in making safe a locomotive boiler as against explosions," and also erred in authorizing the jury to decide that "the standard of duty imposed by the law required a fusible safety plug to be installed." The carriers were left free to determine how their boilers should be kept in proper condition for safe use. The things required for that purpose were not prescribed or changed by the act. Defendant was not liable for failure to furnish the best mechanical contrivances or to discard appliances upon discovery of later improvements. * * * It is not for the courts to lay down rules which will operate to restrict the carriers in their choice of mechanical means by which their locomotives are to be kept in proper condition. The presence of absence of a fusible plug was a matter properly to be taken into consideration in connection with other facts bearing upon the kind and condition of the boiler in determining the essential and ultimate question, i. e., whether the boiler was in the condition required by the act."

Judgment for plaintiff was reversed.—Baltimore & Ohio v. Groeger. Decided January 5, 1925. Opinion by Mr. Justice Butler.

"B. & O. Plan" being put into operation in Moncton shops of C. N. R.

Steadier employment, better working conditions, greater output and improved service to the public are expected from the application of the "Baltimore & Ohio plan" which will be put into operation in the Canadian National shops throughout the Dominion. At the present time Captain O. S. Beyer, consulting engineer for the Railway Employees' Department of the A. F. of L. at Washington, is in Moncton, N. B., headquarters of the Atlantic Region of the Canadian National Railway, making the necessary arrangements. Surveys carried on for some months have been completed and at a recent meeting Captain Beyer addressed the men in Moncton and was given a cordial reception. When the plans are completed questions of interest to the management and the men will be dealt with through committees, which are already in existence, but which in the past have concerned themselves only with grievances.

Western roads settle with enginemen

Settlements on wage increases and changes in working rules for engine service employees have now been made by virtually all of the larger western railroads during the past week. The settlements in general follow the lines of the agreement of the Southern Pacific with its enginemen, which granted a wage increase of approximately 6 per cent, with minor changes in working rules.

The revisions of working rules made by the various roads are as follows. The Gulf, Colorado & Santa Fe adopted a 20 mile-an-hour speed basis for computing overtime in passenger service and adopted rules providing for no duplication in payment for arbitraries or special allowances with passenger road overtime; covering emergency side or lap back trips between terminals; and covering emergency short trips into and out of terminals in connection with their own trains. The wording in doubling hills and tonnage rules was also changed so that the management may avoid making ratings of engines over entire districts and giving the management an opportunity to change ratings at points where grades break in a district. The dead-head rule was also amended so as to provide that no compensation would be allowed for dead-heading resulting from the limitation of the Chicago joint working agreement. On the Chicago & North Western, a rule was adopted providing for emergency short runs in and out of terminals in connection with all trains to be paid continuous time or mileage when made under conditions such as engine failure, running for fuel or water, running for wreck car or carmen or on account of derailment. Rules were also adopted providing that in emergency combination hostler and road service or emergency com-

LOCOMOTIVE REPAIR SITUATION

Date, 1924	No. locomotives on line	No. serviceable	No. stored serviceable	No. reg. classified repairs	Per cent	No. reg. running repairs	Per cent	Total req. repairs	Per cent
February 1	64,377	53,586	4,116	5,919	9.2	4,872	7.6	10,791	16.8
April 1	64,363	52,805	4,648	6,128	9.5	5,430	8.4	11,588	17.9
July 1	64,416	53,382	7,117	6,035	9.4	4,999	7.7	11,034	17.1
October 1	64,538	53,209	5,424	6,175	9.6	5,154	8.0	11,329	17.6
January 1, 1925	64,384	53,118	4,849	5,927	9.2	5,339	8.3	11,266	17.5
February 1, 1925	64,308	52,994	4,220	6,143	9.6	5,171	8.0	11,314	17.6

Data from Car Service Division reports.

FREIGHT CARS ORDERED, INSTALLED AND RETIRED

Month 1924	Installed during month	Aggregate capacity tons	Retired during month	Aggregate capacity tons	Owned at end of month	Aggregate capacity tons	Building in R. R. shops
January	15,589	707,367	12,329	516,695	2,310,032	100,644,107	2,417
February	11,386	554,481	10,466	411,228	2,310,570	100,767,731	2,715
March	9,962	446,094	8,726	352,481	2,311,405	101,165,332	2,697
April	8,718	369,978	8,026	306,288	2,312,074	101,223,891	2,739
May	9,199	439,516	9,059	360,212	2,312,237	101,303,200	2,467
June	10,909	538,118	8,347	321,094	2,314,798	101,569,593	2,269
July	16,583	1,151,302	8,413	316,927	2,322,968	102,388,652	4,602
August	15,452	785,288	8,834	333,173	2,329,582	102,845,000	3,618
September	15,455	779,078	9,337	370,607	2,336,147	103,270,000	3,045
October	16,598	834,762	10,504	*418,816	2,342,149	103,688,000	*3,574
November	11,705	579,234	10,678	463,970	2,342,479	103,767,000	5,159
December	6,763	311,254	11,918	488,035	2,337,229	103,585,000	6,478
Total for year	148,319	....	116,637				

*Corrected figure.

Figures as to installations and retirements prepared by Car Service Division A. R. A. Figures cover only those roads reporting to the Car Service Division. They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

bination hostler and yard service engineer or fireman will be paid for the entire service at the highest rate applicable to any class of service performed with a minimum of a day's pay for the combined service. On the Burlington, a rule was adopted providing that outside hostler's rate is not to apply on account of use of yard tracks supplying power with fuel, water and sand. Another rule was adopted that hostlers will be permitted to handle relief engines and be paid outside hostler's rates. The Los Angeles & Salt Lake revised several rules in accordance with the changes made by the Gulf, Colorado & Santa Fe.

Labor board decisions

The Railroad Labor Board has ordered the following wage increases in rates of pay of the clerical employees on the International-Great Northern represented by the Brotherhood of Railway and Steamship Clerks, Freight Handlers, Express and Station Employees: Storekeepers, assistant storekeepers, chief clerks, foremen and other clerical supervisory forces, two cents an hour; clerks with one or more years of experience, two cents an hour; clerks with less than one year's experience, one cent an hour; train and engine crew callers, assistant station masters, train announcers, gatemen and baggage room employees, two cents an hour; janitors, elevator operators and watchmen, one cent an hour; office boys and messengers, no increase; freight handlers and truckers, one cent an hour; sealers, scalers and inspectors, one cent an hour above truckers' rates; stowers, loaders and coopers, two cents an hour above truckers' rates; common laborers, an increase of two cents an hour; telephone switchboard operators, no increase.—*Decision No. 2784.*

The Railroad Labor Board has decided that an employee who is regularly assigned to positions with Sundays off shall be paid time and one-half for work performed on Sundays while working temporarily in place of another employee whose relief day is other than Sunday. The employee shall not be required to lay off on the relief day of the employee whose position he is filling temporarily if he desires to work.—*Decision No. 2892.*

New York Central employees buy twelve millions of stock

The New York Central announces that 41,570 employees have accepted the company's offer of stock in the corporation at 110, which is about $12 per share below the market price. Stock worth more that $12,000,000 was subscribed for. Approximately one employee out of every four on the system is on the list of subscribers and the number of common stockholders is more than doubled. Originally the offer was limited to 35,000 shares but 68,747 additional shares were later added.

All subscriptions for one or two shares will be filled under the allotment plan. Subscribers for three or four shares will receive two shares; subscribers for five to eight, three shares; nine to twelve, four shares; thirteen to sixteen, six shares. Payment is to be made in monthly installments. Before this offer was made the New York Central had 36,500 stockholders. There will now be about 78,000. Subscriptions from the various roads in the system were: New York Central, 23,689 individuals; Big Four, 8,821; Michigan Central, 3,624; Indiana Harbor Belt, 1,919; Chicago Junction Railway, 1,472; Pittsburgh & Lake Erie, 1,234; Boston & Albany, 811. Subscriptions for one share were received from 23,103 employees; for two to five shares from 15,963 employees; six to ten shares, 1,757 employees, and eleven to twenty shares, 747 employees.

Wage statistics for November

Class I railroads reported for the month of November, 1924, a total of 1,788,723 employees, a decrease of 33,893, or 1.9 per cent as compared with the returns for October, 1924, according to the Interstate Commerce Commission's monthly bulletin of wage statistics. This reduction in employment is largely attributable to seasonal reductions in the maintenance of way and structures forces. The total compensation decreased $19,421,725, or 7.6 per cent. The difference between the per cent of decrease in compensation and that in employment is explained by the fact that there were only 24 working days in November, while there were 27 in October. Compared with the returns for the corresponding month last year the employment shows a decrease of 5.8 per cent and the compensation a decrease of 5.5 per cent.

Meetings and Conventions

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next meeting May 26-29, inclusive, Alexandria Hotel, Los Angeles, Cal.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin ave., Chicago.

American Railway Association, Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Business meeting to be held in Chicago June 16, 17 and 18. No exhibit of railway supplies and machinery will be held.
Division V.—Equipment Painting Section.—V. R. Hawthorne, Chicago. Next meeting September, 1925.
Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York. Next meeting May 19, 20 and 21, at St. Louis, Mo.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention August, 1925, Hotel Sherman, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division. A. F. Steubing, Bradford Corp., 25 West Forty-third street, New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting, June 22-26, Chalfonte-Haddon Hall, Atlantic City, N. J..

Association of Railway Electrical Engineers—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 20-24, Hotel Sherman, Chicago.

Canadian Railway Club.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings second Thursday each month, Hotel Statler, Buffalo, N. Y. Next meeting March 12. Paper on Uniform Interpretation of National Demurrage Rules and Charges will be read by J. F. Chalfaut, manager, department of demurrage supervision, A. R. A. Interim meeting April 9. Paper on Milling in Transit, Mixing in Transit and Reconsigning by W. B. Ewington, freight agent, Nickel Plate, Buffalo.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland. Next meeting March 20. Discussion A. R. A. rules.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention, Hotel Winton, Cleveland, Ohio, August 18, 19 and 20.

International Railway Fuel Association.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill. Next annual convention May 26-29, Hotel Sherman, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Annual convention September 8-11, Hotel Sherman, Chicago.

Master Boiler Makers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Next convention May 19-25, Hotel Sherman, Chicago.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting March 10. Forty-second annual meeting. Election of officers; reports. Address by Judge J. W. Redmond, general counsel, Central Vermont.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth St., New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday in month, alternately in San Francisco and Oakland, Cal. Next meeting March 12, Hotel Oakland, Oakland, Cal. Paper on Railroad Public Relations will be read by Ben S. Allen, director of public relations, Key System Transit Company. Railroad Advertising will be discussed by Charles W. Duncan, advertising counsellor, Foster & Keliser. Election of officers.

Railway Club of Greenville.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in each month, except June, July and August.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

Traveling Engineer's Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September 15-18, 1925, Chicago.

Western Railway Club.—Bruce V. Crandall, 189 West Madison St., Chicago. Next meeting March 16. Paper on Training of Apprentices will be read by C. G. Juneau, master car builder, C. M. & St. P.

Supply Trade Notes

The Chicago Metal Packing Company, Chicago, has changed its name to the Chicago Rhopac Products Company.

The Pantasote Company has removed its New York office from 11 Broadway to 250 Park avenue, New York City.

The Moline Foundry Company, Moline, Ill., has changed its name to the Moline Foundry & Machine Company.

The Weston Electrical Instrument Company, Newark, N. J., has changed its name to the Weston Electrical Instrument Corporation.

Harry S. Smith has been appointed railroad sales representative for the McMaster-Carr Supply Company, with headquarters in Chicago.

C. F. McCuen, formerly general sales agent of the Camel Company, Chicago, has been placed in charge of sales of W. H. Miner, Inc., Chicago.

W. R. Danley is now president of the Roto Company, Hartford, Conn., makers of boiler tube cleaners. Mr. Danley succeeds J. D. Cherry, who died on January 3.

James F. Twohy, secretary of Twohy Bros., railroad contractors, Seattle, Wash., has been elected vice-president of the Pacific Car & Foundry Company, Seattle, Wash.

W. R. Danley is now president of The Roto Company, Hartford, Conn., makers of boiler tube cleaners. He succeeded as president J. D. Cherry, who died on January 3.

A. S. Taylor, formerly sales engineer of the United Alloy Steel Corporation, Canton, Ohio, is now sales engineer of the Central Steel Company, Massillon, Ohio.

The Orton & Steinbrenner Company, Chicago, has appointed the William M. Bailey Company, Pittsburgh, Pa., representative for Pittsburgh and surrounding territory.

Lawrence Wilcox has been appointed representative in charge of the Columbus, Ohio, district of the Westinghouse Air Brake Company, to succeed S. D. Hutchins, deceased.

Glenn Grenville Howe, for many years senior vice-president of the Link-Belt Company, Chicago, died on December 25, at his home, in Muskegon, Mich., after a long illness.

John Y. Sloan, sales agent of the Pullman Car & Manufacturing Corporation, with headquarters at Chicago, has been promoted to manager of sales, with the same headquarters.

A. C. Cook, general sales manager of the Warner & Swasey Company, Cleveland, Ohio, has been promoted to vice-president and has been elected a member of the board of directors.

Norman J. Keyser, traffic manager for the Buffalo Forge Company, Buffalo, N. Y., has resigned to become head of the traffic division of the Kardex Company, at Tonawanda, N. Y.

James F. Hamilton, engineering and sales representative of the Worthington Pump & Machinery Corporation, has been promoted to manager of the newly opened sales office in Milwaukee, Wis.

E. R. Kenner, assistant sales manager of the Wellman-Seaver-Morgan Company, Cleveland, Ohio, has been appointed special representative of the H. K. Ferguson Company, Cleveland, Ohio.

The Joseph Dixon Crucible Company, Jersey City, N. J., has removed its Boston, Mass., office from 49 Federal street to 80 Federal street, which is the new Chamber of Commerce building.

The Ralston Steel Car Company, East Columbus, Ohio, is planning the construction of a one-story addition to its main plant, a new axle and wheel building and a paint and waste storage building.

The Premier Equipment Corporation, Houston, Tex., has been organized to take over the Houston Railway Car Company and will repair, buy and sell locomotives, cars, and other railway equipment.

Carl A. Pinyerd, representative of the Safety Car Heating & Lighting Co., at Chicago, has been appointed district engineer in charge of engineering and service matters, with headquarters at Chicago.

Walter S. Austin, mill representative of A. M. Castle & Co., with headquarters at Chicago, has been appointed general manager of sales for the Los Angeles Iron & Steel Company, Los Angeles, Cal.

The Landis Machine Company of Waynesboro, Pa., manufacturers of thread cutting die heads and threading machinery, has opened an office in Detroit at 5928 Second boulevard, in charge of J. W. Frey.

C. L. Wilkins, representative of the Walworth Manufacturing Company, with headquarters in Chicago, has been promoted to manager of the railroad and industrial department, to succeed J. E. Walsh, resigned.

John Heller, whose appointment as sales manager of the International Oxygen Company, Newark, N. J., was reported in the February issue of the *Railway Mechanical Engineer*, has been elected secretary of the company.

Lynn W. Nones has been appointed eastern sales manager of the Diamond Power Special Corporation, in charge of the Atlantic Coast offices from Boston, Mass., to Charlotte, N. C., inclusive. His office is at 90 West street, New York.

The American Car & Foundry Company will remove its operating and auditing departments about May 1, from 165 Broadway to the sixth floor of 30 Church street, New York City. The executive and other departments will follow about May, 1926.

W. H. Wiewel, assistant general sales manager of the United Alloy Steel Corporation, Canton, Ohio, has been appointed district sales manager of the Standard Seamless Tube Company, with headquarters at New York, to succeed B. F. Bart, resigned.

Carter P. Whitcomb, assistant sales agent of the Griffin Wheel Company, Chicago, in the New England territory, with headquarters at Boston, Mass., has been transferred as sales agent to the Pacific Coast territory, with headquarters at San Francisco, Cal.

Herbert H. Moffitt has been appointed southeastern representative of the Union Railway Equipment Company, with headquarters at Washington, D. C.; S. Clyde Kyle and N. Elliott have been appointed Pacific coast representatives, with headquarters at San Francisco, Cal.

H. Barney Gegenbach has been appointed western sales manager of the Hale-Kilburn Company, Philadelphia, Pa., in charge of its western sales office in Chicago. Mr. Gegenbach has been serving as acting western sales manager for over a year, since the death of Harry R. Rochester.

At a special meeting of the board of directors of the American Car & Foundry Export Company, New York, Oscar B. Cintas was elected a vice-president and director succeeding Charles S. Gawthrop, deceased. Mr. Cintas until his recent election was representative for the company in Cuba.

William R. Van Nortwick, who for the past seven years has been district sales manager at New York for the Roto Company, Hartford, Conn., has severed his connections with that company. Mr. Van Nortwick has opened offices at 50 Church street, New York, for the sale of material to buyers in the combustion field.

The Electric Arc Cutting & Welding Company, Newark, N. J., has opened a branch office at Syracuse, N. Y., in charge of William P. McCarthy. This office is completely equipped to handle all sales and distribution of welding machines and supplies for the entire state, exclusive of the Metropolitan district.

N. A. Campbell, field representative of the New York Air Brake Company, New York, died suddenly in Boston, Mass., on February 4, at the age of 60. He had been connected with the New York Air Brake Company for 25 years as field representative, originally in the western territory, but in recent years he covered the New England territory.

The Harnischfeger Corporation, Milwaukee, Wis., has moved its Atlanta, Ga., office to 303 Peninsular Casualty building, Jacksonville, Fla. W. J. Dugan, southern sales manager, will be in charge of the office and F. W. Truex, sales engineer at Atlanta, has been transferred to Jacksonville. G. H. Lillard and H. A. Wolcott have been appointed sales engineers, with headquarters at Jacksonville.

Willard D. Smith has been appointed manager of railroad sales of the Davis Boring Tool Company, St. Louis, Mo. C. C. Koeln, formerly in charge of production, has been transferred to the New York territory to take charge of eastern sales. Mr. Koeln should be addressed at the home office in St. Louis until his headquarters have been definitely located in the east.

Lewis O. Cameron, Munsey building, Washington, D. C., has been appointed district representative of the General American Car Company, Chicago. Mr. Cameron will handle sales on the southeastern railroads. He was formerly with the Pressed Steel Car Company, and for the last few years has been representing railway equipment companies in Washington.

Lynn B. Easton, manager of the Laidlaw works of the Worthington Pump & Machinery Corporation, New York, died at Cincinnati, Ohio, on January 24 at the age of 40. Mr. Easton had served for over 20 years at Laidlaw, in the sales department of the corporation, having started as time clerk, and then held many positions until he became manager of the works.

J. E. Walsh, manager of the railroad and industrial department of the Walworth Manufacturing Company, with headquarters in Chicago, has been appointed vice-president of Warren Corning & Co., to succeed T. R. Riley, resigned. H. F. Freyberg, office manager of the Vacuum Oil Company, with headquarters in Chicago, has been appointed secretary-treasurer to succeed H. G. Cook, resigned.

The sales department of the Baltimore office of the Symington Company has been removed to New York and continues under the jurisdiction of R. H. Gwaltney, vice-president in charge of eastern and southern sales, with headquarters in the Woolworth building, New York. I. O. Wright, sales engineer, with office in the Maryland Trust building, will continue to represent the Symington Company on the railroads having their principal offices in Baltimore. C. R. Naylor, sales agent at 2108 Straus building, Chicago, has been appointed manager western sales.

Charles J. Graham, vice-president of the Graham Bolt & Nut Company, Pittsburgh, Pa., who in December bought the Gould Coupler Company and the Gould Storage Battery Company from Commodore Charles A. Gould, has disposed of his holdings to a group of New York bankers who are acting for the Symington interests. The new company will be the Gould Coupler Company of Maryland, and William S. Gould, vice-president of the old company, will be president of the new company. The policies of the old company will be continued under Mr. Gould's direction, and there will be no material change in the management. This statement is authorized by Charles J. Symington, president of the Symington Company.

Frederick C. Riddile, general manager of the Edgewater Steel Company, Pittsburgh, Pa., died on December 21 at the Columbia Hospital, Pittsburgh, after a short illness, at the age of 59 years. Mr. Riddile was born in Burgettstown, Pa. His early life was spent in Pittsburgh, and as a young man he entered the employ of the Oliver Iron & Steel Company, later becoming associated with the Latrobe plant of the Railway Steel Spring Company. He then went to Chicago Heights, Ill., as general superintendent of the Inter Ocean Steel Company, and since the organization of the Edgewater Steel Company in 1916 he has been its general manager.

E. I. Cornbrooks has been appointed sales manager of the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., succeeding Benjamin G. Fernald, who has resigned on account of ill health. Mr. Cornbrooks has been connected with the company for nearly twenty years, serving first as chief draftsman in the hull department and later as superintendent of hull construction and superintendent of construction. He has had an important part in the development of the company's new products, including railroad equipment and large hydraulic turbines and accessories such as regulating gates, valves, penstocks and surge tanks.

L. D. Whitaker, who recently severed his connection with the United States Steel Corporation, has become associated with Ralph W. Payne in the railway supply business at Washington, D. C. He was born at Salisbury, N. C., on May 25, 1898. He was educated in the North Carolina public schools and is a graduate of Emerson Institute, Washington, D. C., and the Law School of George Washington University, also spending three years in the arts and sciences department of that institution. He was connected with the American Surety Company of New York, from 1914 to 1917, and then entered the Washington sales office of the United States Steel Corporation, where he has since been located with the exception of one year in the marine corps during the war.

Albert Waycott, founder and former president of the Damascus Brake Beam Company, Cleveland, Ohio, died on January 15 in a hospital in San Francisco, Cal., following an attack of heart disease, which occurred while he was returning from a trip to Panama. He was born in St. Andrews, New Brunswick, and came to St. Louis, where he organized the firm of Albert Waycott & Co., in 1897, and engaged in the sale of brake beams. In 1903 he organized the Damascus Brake Beam Company in St. Louis, Mo., and was president of this company until 1917, when he became chairman of the board. In 1918 he moved to New York and became an inactive member of the board, remaining so until the sale of the Damascus Brake Beam Company to the American Steel Foundries Company, which occurred in 1924.

The Youngstown Steel Door Company has been incorporated in Chicago to engage in the manufacture and sale of steel doors for railway freight cars and has acquired all of the assets and patent rights of the Steel Door, Inc., and the American Steel Door Company. James A. Campbell, president of the Youngstown Sheet & Tube Co., is president of the new company. Charles B. Moore, vice-president of the Oxweld Railroad Service Company, Chicago, is vice-president. John P. McWilliams, general manager of the Oxweld Railroad Service Company, with headquarters at Chicago, has been appointed vice-president and general manager, with headquarters in Cleveland, Ohio. Directors of the new company are J. A. Campbell, Youngstown, Ohio, H. S. Coulby, Cleveland, H. D. Dalton, Cleveland, J. T. McWilliams, Cleveland, C. B. Moore, Chicago, F. F. Prentiss, Cleveland, and J. L. Severance, Cleveland. John P. McWilliams was born on January 8, 1891, in Chillicothe, Ohio, and graduated as a civil engineer from Princeton University in 1913. He entered railway service in 1913 as a timekeeper on the Grand Trunk Pacific, which position he held until October, 1914, when he entered the employ of the Oxweld Acetylene Company. He was promoted to sales manager in 1916. In 1917 he entered the employ of the Oxweld Railroad Service Company as assistant to the vice-president. He was commissioned a captain in the Motor Transport Corps of the United States Army in 1918 and later served as an executive officer of the Welding School at Camp Holabird, Md. He re-entered the employ of the Oxweld Railroad Service Company in 1919 as assistant to the president, with headquarters at New York, which position he held until 1921, when he was promoted to general manager, with headquarters at Chicago. He held the latter position until December 31, 1924, when he resigned to become vice-president and general manager of the Youngstown Steel Door Company.

J. P. McWilliams

David B. Rushmore, one of the consulting engineers of the General Electric Company, Schenectady, N. Y., has resigned and is now located in New York City, with headquarters at the University Club. He graduated from Swarthmore College in 1894 with the degree of bachelor of science and engineering and from Cornell University the following year in the electrical engineering course. In 1897 he received the degree of civil enginer from Swarthmore College and in 1923 the honorary degree of doctor of science from the same college. Mr. Rushmore was with the Westinghouse Electric & Manufacturing Company, and later with the Royal Electric Company of Montreal previous to his service of 25 years with the General Electric Company and the Stanley Electric Company, Pittsfield, which was absorbed by the General Electric Company. In 1905 he went to Schenectady, and for 17 years was engineer of the power and mining department.

The firm of Cook & Riley has been incorporated in Chicago to deal in railway and industrial supplies. It will represent the J. Milton Hagy Waste Works, the E. Arnstein Paint Company, and the Universal Coupling Company. The organizers are T. R. Riley, vice-president, and H. G. Cook, secretary and treasurer of Warren Corning & Co., Chicago.

Laughlin & Cheney, Inc., has been organized, with headquarters at 310 South Michigan avenue, Chicago, by P. L. Laughlin, district sales manager of the Verona Tool Works, with headquarters at Chicago, and B. M. Cheney, general inspector of permanent way and structures, Chicago, Burlington & Quincy, with headquarters at Chicago. The new firm will deal in railway supplies, specializing in the products of the Verona Tool Works.

Le Roy Kramer, vice-president in charge of western sales of the Symington Company, with headquarters at Chicago, has been appointed vice-president in charge of manufacturing and sales of the General American Tank Car Corporation, with headquarters in Chicago. He spent several years in the operating department of the St. Louis-San Francisco and the Chicago, Rock Island & Pacific and from 1912 to 1918 was vice-president of the Pullman Company in charge of the manufacturing and repair shops. During 1918 and 1919 he was federal manager of the St. Louis-San Francisco and the Missouri-Kansas-Texas. In 1919 he was appointed vice-president of the Willys-Overland Company and in 1921 he was appointed vice-president in charge of western sales of the Symington Company, with headquarters at Chicago.


Le Roy Kramer

American Car & Foundry Company

At a special meeting of the board of directors of the American Car & Foundry Company, New York, on February 15, Herbert W. Wolff, vice-president of the company and G. R. Scanland were elected directors. Mr. Scanland, who has for years been auditor of the company, was elected also vice-president in charge of finances and accounts; S. A. Mallette, assistant treasurer, was elected treasurer to succeed S. S. DeLano, deceased; E. S. Block, assistant auditor was made auditor and Miss Alma E. Jackson was appointed assistant treasurer. Mr. Wolff will retain his office in Chicago and continue in charge of sales in that territory. The other officers will be located in New York. G. R. Scanland, the new vice-president and director, was born at Pittsfield, Ill., on May 8, 1877. He entered the employ of the American Car & Foundry Company as a clerk in the auditing department in 1899 and five years later was appointed local auditor of the Memphis district. In 1905 he was appointed traveling auditor and in December of the following year was elected assistant auditor. In November, 1917, Mr. Scanland was elected auditor and now becomes vice-president in charge of finances and accounts and a director. S. A. Mallette, the new treasurer, was born at Union City, Conn., in 1870. He served in the automatic block signal field after leaving school and joined the American Car & Foundry Company when it was organized in 1899. In 1905 he was elected assistant treasurer. E. S. Block, who has been appointed auditor, was born at St. Louis, Mo., on Aug. 31, 1879. He began work as a clerk in the general auditing department of the American Car & Foundry Company in 1900 and was appointed general bookkeeper in 1906. He was appointed traveling auditor in 1911 and in November, 1917, was elected assistant auditor. Miss Alma E. Jackson, who has been appointed assistant treasurer, was born in Callaway county, Mo., and was educated in the public schools, graduating from the St. Louis high school in 1899. She began work with the American Car & Foundry Company in 1900 as a stenographer and now becomes assistant treasurer.

Trade Publications

RIVETERS.—Bulletin R-201, illustrating and describing Hanna pinch bug riveters, has just been issued by the Hanna Engineering Works, Chicago, Ill.

CRANES.—A new general catalogue and a new locomotive crane catalogue have been prepared by the American Hoist & Derrick Company, St. Paul, Minn.

CENTRIFUGAL PUMPS.—"Worthington Centrifugal Pumps Serving Every Industry," is the title of Bulletin No. W-607 which has recently been issued by the Worthington Pump & Machinery Corporation, New York.

ELECTRIC TRAMRAIL.—An eight-page circular illustrating a few of the various plants served by Cleveland hand or electric tramrails, has been issued by the Cleveland Crane & Engineering Company, Wickliffe, Ohio.

CO_2 EQUIPMENT.—Bulletins No. 118 and 118A descriptive of the Apex CO_2 recorder and the principle of operation of the Apex pneumatic CO_2 meter and indicator, have been issued by the Uehling Instrument Company, Paterson, N. J.

LOCOMOTIVE HOISTS.—A circular briefly outlining the savings which may be effected through the use of a locomotive hoist and showing various applications of the Whiting hoist, has been issued by the Whiting Corporation, Harvey, Ill.

COMBINATION GRINDING AND BUFFING MACHINES.—Bulletin No. 1582, descriptive of four new types of motor driven combination grinding and buffing machines, built in ½ and 1 hp. sizes with open and encased spindle extensions, has been issued by the Hisey-Wolf Machine Company, Cincinnati, Ohio.

OIL-ELECTRIC LOCOMOTIVE.—Bulletin No. 44103.1, descriptive of the 60-ton oil-electric locomotive developed by the General Electric, the American Locomotive and the Ingersoll-Rand Companies, is being issued by the General Electric Company, Schenectady, N. Y. Photographs of the locomotive in service, views of the interior, and tables of operating data and specifications, as well as a general description, are included in the booklet.

BORING TOOLS AND REAMERS.—Railroad catalogue No. 25, giving a complete description of Davis expansion boring tools as standard equipment for railroad shops, has been issued by the Davis Boring Tool Company, St. Louis, Mo. The catalogue contains a complete treatise on Davis expansion car wheel boring tools for the car department, and a completely new line of boring tools and reamers recently developed for the locomotive departments of the railroads.

STOKERS.—A bulletin descriptive of the self-contained traveling grate stoker, which has been installed throughout the British Isles and Continental Europe, has been issued by the Combustion Engineering Corporation, New York. The stoker is adaptable to a wide range of fuels, including non-coking bituminous coals, anthracite coals, coke breeze and lignites, and may be applied to boilers of all sizes and types, it being particularly suited to boilers ranging up to 600 hp.

BALANCING GRINDING WHEELS.—The Norton Company, Worcester, Mass., has issued a 24-page brochure entitled, "The balancing of grinding wheels," in which the advantages and economy of balancing the grinding wheel are briefly outlined. Balancing for precision grinding and the balancing of flanges for off-hand grinding are then discussed and directions for balancing off-hand wheels given. The principle of adjusting the balancing weights to obtain a range from the maximum to the minimum counter-balance is also shown.

CAR SILL SECTIONS.—Sectional drawings of center sill section B 112 and side sill channel C 211 are shown in an eight-page brochure issued by the Carnegie Steel Company, Pittsburgh, Pa. The center sill section is the A. R. A. design incorporated in 1923 in the proposed designs for four standard box cars, a relatively large number of which have since been built. The side sill channel, while not an A. R. A. design, has been accepted for use on cars already built, considerable lateral stiffness being afforded by the wide flanges with which it is rolled and to which side framing and floor system can be readily attached.

Personal Mention

General

T. M. KIRKBY, mechanical assistant to the general superintendent of motive power of the Chicago, Milwaukee & St. Paul, with headquarters at Chicago, has been promoted to special representative, with the same headquarters.

J. S. NETHERWOOD, whose promotion to assistant superintendent of motive power and equipment of the Southern Pacific, Louisiana lines, with headquarters at Algiers, La., was reported in the January issue of the *Railway Mechanical Engineer,* was born on November 18, 1889, at Lohn, Tex. He graduated from the Agricultural and Mechanical College of Texas in June, 1911, and entered railway service immediately thereafter as a draftsman in the office of the mechanical engineer of the Southern Pacific at Houston, Tex. He was promoted to chief draftsman in February, 1913, and held that position until September, 1918, when he was promoted to mechanical engineer of the Texas lines, with headquarters at Houston, Tex. Mr. Netherwood remained in that position until his recent promotion to assistant superintendent of motive power and equipment.

P. W. KIEFER, whose promotion to engineer of rolling stock of the New York Central, with headquarters at New York, was announced in the February issue of the *Railway Mechanical Engineer,* entered railway service as an apprentice in the mechanical department of the Lake Shore & Michigan Southern (now a part of the New York Central) and in 1916 he entered the equipment engineering department. He later served as locomotive designer, leading draftsman and on dynamometer car tests and in July, 1920, he was promoted from the position of chief draftsman in the locomotive department of the equipment engineering department to the position of assistant engineer in the office of the engineer of rolling stock. In March, 1923, Mr. Kiefer was promoted to assistant engineer of rolling stock and in May, 1924, he was promoted to engineer of motive power of the Lines East and West of Buffalo, N. Y.

H. W. WILLIAMS, special representative to the general superintendent of motive power of the Chicago, Milwaukee & St. Paul, with headquarters at Chicago, has been promoted to superintendent of motive power of the Western Lines, with headquarters at Tacoma, Wash., succeeding Frank Rusch, deceased. Mr. Williams graduated from Purdue University in June, 1910, and after one year as an instrument man on the Chicago Junction, entered the service of the Chicago, Milwaukee & St. Paul as a draftsman in the office of the engineer of design. He was transferred to the construction forces at Lewistown, Mont., in December, 1913, and in March, 1914, was promoted to structural draftsman in the electrification department. Mr. Williams was promoted to chief draftsman in January, 1915, and to assistant engineer in 1917. He was appointed special representative to the general superintendent of motive power in November, 1920.

Master Mechanics and Road Foremen

GEORGE HIGGS has been appointed road foreman of engines of the Central of New Jersey, succeeding A. Kirkendall, deceased.

F. T. MCCLURE has been appointed road foreman of engines of the Eastern division of the Atchison, Topeka & Santa Fe, with headquarters at Ottawa, Kan.

E. C. CAREY has been appointed assistant road foreman of engines of the Norfolk & Western, with headquarters at Bluefield, W. Va., succeeding W. F. Perkins, promoted.

G. F. BURKE, general foreman of the Southern Pacific, with headquarters at Roseville, Cal., has been promoted to master mechanic, with headquarters at Tucson, succeeding O. B. Schoenky.

O. B. SCHOENKY, master mechanic of the Southern Pacific, with headquarters at Tucson, Ariz., has been promoted to superintendent of motive power, with headquarters at Los Angeles, Cal., succeeding Patrick Sheedy, who has retired.

JOHN P. MORRIS, whose appointment as master mechanic of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, was announced in the January issue of the *Railway Mechanical Engineer,* was born in 1889 at Fort Madison, Iowa. He attended the Fort Madison public schools, entering the employ of the A. T. & S. F. as a machinist helper on September 27, 1904. He became a machinist apprentice in June, 1906, and from February, 1911, to January, 1916, he was a machinist on the Missouri division. In January, 1916, he was promoted to assistant roundhouse foreman, with headquarters at Shopton, Iowa; in July, 1917, promoted to roundhouse foreman at Fort Madison; and in April, 1923, to general shop foreman, locomotive department, in which capacity he remained until his appointment as master mechanic at Chicago.

J. E. STONE, whose appointment as master mechanic of the Salt Lake division of the Southern Pacific was announced in the February issue of the *Railway Mechanical Engineer,* was born on July 19, 1885, at Shoshone, Idaho. He entered railroad service in 1902 as a machinist apprentice on the Oregon Short Line. From August, 1906, until December, 1908, he was machinist and shop draftsman at Pocatello, Idaho; from January, 1909, until May, 1911, draftsman in the office of the superintendent of motive power at Salt Lake City, Utah; from May, 1911, until April, 1912, draftsman of the Ray Consolidated Copper Company, Ray, Ariz., and from April, 1912, until March, 1913, assistant machine shop foreman of the Oregon Short Line at Ogden, Utah. He was then appointed general foreman. On July 1, 1914, the Southern Pacific took charge of the Ogden shops and Mr. Stone was retained as general foreman until August, 1920, when he was transferred to Sparks, Nev., as assistant master mechanic of the Salt Lake division.

Car Department

W. G. BROWN has been appointed division car foreman of the W. N. & P. division of the Boston & Maine, with headquarters at Worcester, Mass.

ANDREW CRAIG has been appointed division car foreman of the Terminal division-freight, of the Boston & Maine, with headquarters at Charlestown, Mass.

Shop and Enginehouse

FRANK FOUSE has been appointed shop superintendent of the Lehigh Valley, with headquarters at Packerton, Pa.

A. J. DIETRICH, roundhouse foreman of the Atchison, Topeka & Santa Fe at Barstow, Cal., has been transferred to Bakersfield, Cal., succeeding R. T. Gorman.

C. H. WALL, division foreman of the Atchison, Topeka & Santa Fe at Barstow, Cal., has been appointed roundhouse foreman, with headquarters at Richmond, Cal.

R. T. GORMAN, roundhouse foreman of the Atchison, Topeka & Santa Fe at Bakersfield, Cal., has been appointed division foreman, with headquarters at Barstow, Cal.

Purchasing and Stores

D. W. CORCORAN, traveling storekeeper of the Chicago & North Western at Chicago, has been promoted to assistant general storekeeper, with the same headquarters.

F. B. TAYLOR has been appointed division storekeeper of the Iowa division of the Chicago & North Western, with headquarters at Clinton, Iowa, succeeding E. J. Leonard.

W. H. FITZPATRICK, traveling storekeeper of the Chicago & North Western, at Chicago, has been promoted general storekeeper, with the same headquarters, succeeding A. L. Tucker, who has retired.

Obituary

C. F. LAPE, for nine years master mechanic of the Atchison, Topeka & Santa Fe, with headquarters at San Bernardino, Cal., died on January 6, at the age of 81.

ARTHUR KIRKENDALL, road foreman of engines of the Central of New Jersey, with headquarters at Jersey City, N. J., died at his home in Westfield, N. J., on February 4, at the age of 63. He had been in the service of the Central of New Jersey for 42 years.

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Casehardening valve motion parts

The even distribution of steam in the cylinders of a locomotive depends on the proper functioning of the valve motion which, in turn, depends largely on the amount of wear in the pins, bushings, etc., of the gear. The wear of these parts varies, other conditions being equal, to the degree of their surface hardness. The carburization and casehardening of valve motion parts is the key to the situation which is clearly set forth in an article on this subject that appears elsewhere in this issue. There are still many shops and enginehouses that use the old fashion method of casehardening with potash, which hardens only the skin of the parts and does not penetrate into the metal. As a result, regardless of lubrication, the parts wear quickly which soon leads to the improper functioning of the motion.

The installation of a highly developed system for casehardening valve motion parts would eliminate this trouble. First, there should be installed at the larger shops of the railroads a modern, electrically controlled furnace for casehardening. Those who operate the furnace and are in charge of the work should have complete information pertaining to the subject. With the right equipment and properly trained men in charge a system of production can be worked whereby every locomotive repair point on the road may carry in stock valve motion parts properly hardened ready to be touched up on a grinder and applied to the locomotive. Hit and miss methods of heat treatment in railroad shops have passed by and are being rapidly superseded by equipment and practices which produce accurate results.

High purity oxygen economical

The railway industry is a large consumer of oxygen but is it adequately informed of the fact that the higher the purity of the gas, the more economical is its consumption? This fact, along with many other interesting characteristics of oxygen are clearly set forth in an article on the economies effected by the use of high purity oxygen which appears on another page of this issue. It is pointed out that as the purity of the oxygen increases, the consumption and cutting time decreases. Take for example, the cutting of 3/8 in. steel, using 100 cu. ft. of 99.5 per cent oxygen as a basis of comparison. By reducing the purity to 99.0 per cent the consumption is increased to 114.1 cu. ft. Thus, a cylinder containing 200 cu. ft. of 99.0 per cent oxygen would yield, in reality, only 171.8 cu. ft. A car shop using 50 cylinders of 99.0 per cent oxygen a day would lose a potential consumption of 1,410 cu. ft. which would otherwise be available by using 99.5 per cent oxygen. Figuring on a basis of 26 working days a month, a total of 36,660 cu. ft. of the gas, or 183 more cylinders are consumed than would have been necessary by using 99.5 per cent oxygen. This means that 183 more cylinders of oxygen would have to be purchased or, figured on the basis of $1.50 per cylinder, a loss of $274.50.

Now let us turn to the savings effected in the cutting time by using higher purity oxygen. The time required to cut a given length of 3/8 in. steel using 99.5 per cent oxygen is 74 min. and 18 sec. To cut the same steel using 99.0 per cent oxygen requires 84 min., 45 sec., or a difference in time of 10 min., 27 sec. By using 98.5 per cent oxygen, the cutting time is increased 19 min., 6 sec. above the time required for the 99.5 per cent gas. Thus it can be readily seen that a large amount of time would also be lost daily by using oxygen that was not up to a high standard of purity. Since small increments of change in the purity of oxygen have a marked effect on operating costs, the railroads should establish a standard of purity and religiously adhere to it when purchasing oxygen.

Anti-friction bearings for railroad equipment

The demands on a railway car journal are of an exacting nature and they will become more so as cars of greater capacity are built. The problem of increased train tonnage is gradually reaching the stage which will eventually demand a reduction in journal friction. Experience in other industries has indicated that ball bearings can carry comparatively heavy loads at reasonably high speeds, but in order to be successfully applied to railway rolling equipment, ball bearings will have to be of dimensions which are quite impracticable. The roller bearing was developed in the search for an anti-friction bearing that would carry heavier loads. In recent years, we have seen various modifications of both the ball and roller bearings as well as designs involving combinations of the two.

The conditions under which railroad equipment will be operated in the future will demand a journal bearing having a minimum of friction, capable of handling both radial and thrust loads, and easy to maintain; that is, have no loose parts and be capable of quick inspection.

A number of attempts have been made to apply both ball and roller bearings to car journals. However, the capacity of these bearings over the static load was not sufficient to give the long life necessary to economical car maintenance. The greater number of tests of anti-friction journal bearings have been performed on European railway equipment, which is considerably lighter than that used in this country. However, considerable data of value have been obtained as a result of these experiments. The Swedish State railways have conducted a number of experiments with an especially designed shock absorber and data have been collected as to the radial and lateral shocks incurred by a car journal box in actual service. Undoubt-

edly this progress in anti-friction journal bearing design will become as important to the car designer as the three-cylinder or steam turbine developments have been to the locomotive designer. The mechanical engineer employed in the design and maintenance of railway rolling equipment should watch closely the further development of anti-friction journal bearings.

Are brains an asset?

Word was recently passed along the line on a certain railroad that one of its shop superintendents was slipping. An extensive area of the top of his desk had recently begun to show through the piles of correspondence with which it had once been covered. Furthermore, on several occasions he had been found in his office doing nothing, apparently thinking intently. The fears for this officer's future which have begun to find lodgment in the minds of other officers and men up and down the line, and the facts on which they are based are significant. It may be inferred, first, that unless the desk of a minor managing officer is not buried in correspondence, he is not as busy as he should be; and, second, that with no evidence of industry before him, he should never be found sitting at his desk. Apparently he should be seen hurrying from place to place in the shop demonstrating his superior ability by "bawling out" his foremen for their shortcomings. Undoubtedly there should be a place in every superintendent's daily schedule for a personal inspection of the operations over which he has general supervision. With a good organization and competent foremen, however, this need not occupy all or even a major part of his time. Time spent in quiet reflection on the problems of more and cheaper output need by no means be considered as wasted. Men must have four personal instruments with which to make themselves useful; their hands, their feet, their mouths and their brains. The mechanic's usefulness lies largely in the skill with which he can use his hands. It is being recognized more and more, however, that his brains are an asset which also ought to be utilized. The foreman is expected to use his feet and his mouth, the skill and tact with which he uses the latter instrument largely determining the quality of his personality. Here, again, the value of brains in directing the feet and the mouth is constantly receiving more recognition in the attention which is being given to the better selection and training of these direct supervisors. But in the case of an officer who may be responsible for the results of the labor of several hundred men, using several million dollars' worth of facilities, the attempt to make a little more intensive use of his brains in constructive planning than is expected of the mechanic or the foreman should not excite unfavorable comment. If brains are valuable, why not give a little more scope to their activity where it will accomplish the biggest results?

Foreman training

The *Railway Mechanical Engineer* has had much to say in recent years about the necessity of special coaching and training of foremen and supervisors in the art of leadership. It is essential, if the railroads are to be operated economically and efficiently, that there be intelligent and enthusiastic co-operation on the part of all the workers—supervisory and in the ranks. This objective, however, cannot be attained if the foremen and supervisors are indifferent or if they do not have a keen appreciation of the importance of the human element in the organization.

The truth of this has been steadily growing in the consciousness of railway managements in recent years and is indicated in many ways. A notable illustration of this interest is contained in the annual report of the Boston & Maine for the year 1924. This report contains several paragraphs relating to relations between the employees and the management and includes this significant statement: "Educational work of a practical nature has been extended during the year, as opportunity would permit. The foremen's clubs in the mechanical department, organized last year at several points, have been extended over the system and are discussing problems of proper supervision as well as of shop practices, with increased attendance and interest."

Clubs of this sort naturally function best during the winter months, although much can be done among the foremen along educational lines during the entire year. Foremen's clubs of various sorts have functioned to advantage on several railroads during the past year. Attempts to develop such clubs, on the other hand, have failed or have had little results in other places. The importance of the question has been entirely overlooked on not a few railroads. Now is the time to take stock and to consider what steps should be taken to promote this constructive development next year. Why has the movement failed on some roads and been a notable success on others? The foremen are the liaison officers between the management and the men and they can immensely improve an organization or greatly weaken it, depending on whether or not they have a large appreciation of their responsibilities and utilize every advantage to inform themselves as to the best ways of successfully discharging their difficult responsibilities.

Here is another significant quotation from the Boston & Maine report: "It (the management) would fail in its duty alike to the property, to the public and to its own organization if it were to regard the building up of an effective co-operation as of less consequence than the technical problems of operation, maintenance and finance. Urgent as these problems are, under all circumstances, it remains permanently true that the labor and supervision cost is the largest item in the budget, and justifies, for this reason alone if on no broader grounds, special attention to the proper basis for a service distinguished by voluntary interest and good will rather than a mere perfunctory discharge of assigned duties."

Apprentice conferences

Readers of the *Railway Mechanical Engineer,* and its predecessors, have noted not a few times during the past 15 years, reports of system conferences of apprentice instructors. A rather unusual development which has taken place within the past year has been system gatherings of apprentices or younger railroad employees. The Santa Fe had a system apprentice conference at Albuquerque, N. Mex., in March, 1924; it was promoted by some of the boys who attended the first Railroad Younger Men's Conference of the Y. M. C. A., held in St. Louis near the end of 1923. The second apprentice conference on the Santa Fe was held at San Bernardino, Cal., February 19-21 of this year and was attended by 150 picked young men who were sent as delegates from the apprentice clubs on the system. These clubs are maintained by the boys themselves, for their physical, mental and moral development and improvement. The three-day program included reports and discussions on the activities of the various clubs and as to how to make them more effective. The delegates, upon their return home, reported orally to their local clubs and presented written reports of their observations to the local master mechanic or superintendent of

shops. The general results were summed up as follows in an article in a recent issue of the Railway Age: "It is difficult to estimate the good derived from a meeting of this kind. Certainly leadership was developed. Each delegate returned to his home station with a greater love for the work of his trade, a greater appreciation of the plans and purposes of the railway management, and a greater conception of the nobler things of life, a greater degree of co-operation with officials and fellow employees, and a greater determination to make the best of every opportunity offered."

The Chesapeake & Ohio has just held a similar system conference at Huntington, W. Va., but including representation from all of the classes of boys and young men on the railroad, although the larger proportion of the delegates came from the mechanical department apprentices.

The Younger Railroad Men's Conference of the Y. M. C. A. held a second meeting at Detroit last November, at which 279 young men were present, representing 48 railway systems, from 33 states and provinces, and 58 different classifications of occupations.

It will be interesting to watch the development of this new movement and try to trace the beneficial results which will come from it. It would seem that the young men would gain a far greater appreciation of the importance of the railroads from an economic point of view and that they would be inspired to take a larger and more intelligent interest in their work. Instances are already on record where young men going home from these conferences have had a strong and beneficial influence upon their comrades who were not so fortunate as to attend the conference. In applying scientific methods to improve the morale in the army in recent years, a new slogan has been adopted—"The Army Builds Men." The objective is to develop each man in the organization to the fullest extent of his ability. This new movement among the younger men on the railroads would seem to tend in the same direction and should result in getting the young men into that particular class of work for which they are best suited, in making them more happy and contented in their work, and in fitting them to carry larger responsibilities in the future.

Air compressor misalinement

The standards of air compressor maintenance should be kept as high as possible. One of the details which probably gives more trouble than any other single item is inaccurate alinement of the cylinders which may be due to any one of a number of conditions. Whatever the reason, the result is the same—decreased air compressor efficiency, shorter compressor life, increased failures and generally increased operating costs. The following are some of the observed results: Misalinement sometimes causes reversing valve rod chatter, resulting in failure due to a crystallized and broken valve rod. Misalinement causes the pistons to bind and wear on one side at the bottom of the stroke and on the opposite side at the top of the stroke. This binding will continue until the cylinder walls and pistons are worn enough to give free travel; the result is out-of-round cylinders and pistons with excessive clearance and ring gap. Continual binding may also result in the pistons becoming loose on the piston rods and the nuts coming off.

There are cases where the piston has stayed tight on the rod but the continual binding action has crystallized the rod with the result that it snapped off close to the piston. Misalinement causes the piston rings to shift continually in the piston, resulting in undue wear of the rings and grooves and permitting the air to blow by, thus shortening the life of these parts as well as contributing to compressor inefficiency.

One of the greatest difficulties resulting from cylinder misalinement is packing trouble, caused by the side motion of piston rods. Stuffing box nuts must of necessity be drawn exceedingly tight to prevent leaks under this condition and the life of the packing is correspondingly shortened. The air compressor is subjected to continual laboring on account of the tight packing and naturally more steam is consumed in operating pistons that are so hard to move. This excess packing pressure greatly increases wear on the piston rods which is also undesirable.

Fortunately these difficulties can be entirely overcome. Several machines, both grinders and boring machines, are fitted with revolving indexing tables and there is no reason why the same principle may not be adapted to others. With the pump mounted on the indexing table the cylinders may be bored without breaking the joints between the cylinders and the center castings. After boring one end the table may be revolved and accurately set at 180 deg. from its original position, which removes all guess work as to the accuracy of alinement of the cylinders.

Since the misalinement of air compressor cylinders is responsible for so many evils as outlined, it behooves shop superintendents, air room foremen and others responsible for the work of repairing air compressors to check their practice in this respect. If they are having difficulties, probably the method mentioned may solve the trouble.

New Books

Master Blacksmith's Proceedings. *Edited by William J. Mayer, Secretary, 2347 Clark Avenue, Detroit, Mich.* 133 *pages* 5½ *in. by* 8 *in. Bound in Cloth.*

Those interested in the methods employed in the manufacture and repair of car and locomotive parts in the blacksmith shop should obtain many helpful suggestions from the papers contained in this report of the proceedings of the twenty-eighth annual convention of the International Railroad Master Blacksmiths' Association, held at the Hotel Sherman, Chicago, August 19, 20 and 21, 1924. Considerable attention is given to the manufacture and repair of frames, springs, draw bars and pins. The book is well illustrated.

Traveling Engineers' Association. *Edited by W. O. Thompson, Secretary, Cleveland, Ohio.* 386 *pages,* 5½ *in. by* 8½ *in. Bound in Cloth.*

A wealth of material of interest to traveling engineers, road foremen of engines and others, is contained in this report of the proceedings of the thirty-second annual convention of the Traveling Engineers' Association, held at Chicago, September 16, 17, 18 and 19, 1924. Following a list of the 1924-1925 officers in the front of the book is the constitution of the Traveling Engineers' Association and a brief report of the subjects considered at each convention since the first held at Chicago in 1893. The report of the convention is divided into seven parts, one for each session. Among the nine papers read during the convention were those dealing with the following subjects: Conservation of locomotive fuel; Lubrication and its effect on locomotive service; Locomotive boosters and their effect on locomotive design and train operation; Relation between terminal facilities and locomotive service; Automatic train control devices. These papers have been for the most part, printed in abstract in the

Railway Mechanical Engineer. A comprehensive index in the back of the book enables any of the papers as well as the discussions by the various members, to be located readily.

What Our Readers Think

What advantages have floating bushings?

San Antonio, Tex.

To the editor:

Will you please advise what advantage floating bushings on back end main rods and middle connections have over the solid stationary middle connection bushing and the old style two-piece back-end brass? I have in mind heavy power, with 25 in. by 30 in. cylinders. These rods develop a pound in five to ten thousand miles and run very hot even after 90 days' wear.

The information desired is, what are the advantages of floating bushings for heavy power and are they more economical than the old style referred to? S. J. Stark,
General roundhouse foreman, International-Great Northern.

Question pertaining to the wear of locomotive air compressor cylinders

Lincoln, Neb.

To the editor:

It has come to my attention recently that the air cylinders of 9½-in. and 11-in. air pumps wear most at the end while the air cylinders of 8½-in. compound pumps wear most near the middle. The first case is not uncommon, but the latter appears to me as a rather unusual place for the cylinder walls of compound pumps to wear as they are more evenly balanced in their action than the single acting pumps.

I would like to see published in the columns of your magazine an explanation as to why air pump cylinders wear in this manner, and also if there are any possible means of overcoming this trouble. R. J. K.

Derailments of locomotives—a criticism

Philadelphia, Pa.

To the editor:

I think you have met the needs of many master mechanics and motive power men in the article on the derailments of locomotives on curves, published in the December, 1924, and January, 1925, issues of the *Railway Mechanical Engineer,* quite creditably. The authors have given an interesting picture of the tracking of a locomotive around a curve.

In the tracking of a locomotive around a curve, knowing the extent of both the flange and hub plays, the elevation of the outer rail, the speed and center of gravity of the locomotive and the drawbar pull, assuming that the locomotive is equipped with flat tires, and accurate data is available relative to the truck hangers and back lash of the truck, only one assumption is needed for the determination of all the forces, and that is the co-efficient of friction at the various wheel contacts with the rail. Several trial assumptions of the center of rotation or friction center will facilitate a solution of the general equations, but there is only one center of rotation which will satisfy the center of rotation of the wheel base. It is interesting to know that the center of rotation can be determined experimentally. This was actually done on the Chicago, Milwaukee & St. Paul's electric locomotives and with all the above data available, the computations checked fairly accurately with the actual test loads, etc.

A moment's inspection of Fig. 5, which is shown on page 17 of the January, 1925, *Railway Mechanical Engineer,* will show that the forces considered are inconsistent with the condition of kinetic equilibrium and that a very important reaction has been omitted in the analysis; that is, the reaction of the inner rail on the fourth driver outwards. No assumption is needed for the friction center, though trial values would facilitate the solution of the equations. Moreover, if traction is assumed, the friction center would probably lie beyond the outer rail, while without traction on the curve, the center of rotation must lie along the center line of the locomotive. The assumption of the main driving axle for the position of the friction center is possible, though my trial value would be at first, at the fourth driver.

In the configuration diagrams of the wheel base on a curve, the diagrams indicate a swing of the trailing truck comparable to the swing of the engine truck. This is, of course, due in greater part to the assumed forward position of the center of rotation. It is interesting to note, however, that the swing of the trailing truck is but from one-third to one-half of that of the engine truck.

One serious objection to this article is the lack of the use of some exaggerated graphical method for giving the configuration on the track as is given by the Roy diagram. Then too, no consideration is given to flange and hub plays which have an erroneous bearing on the configuration of the wheel base, especially in such types as the Santa Fe locomotives.

The analysis of the reactions of the truck are in error, due to failure in considering the lateral thrust at the center pin bearing U. Thus the vertical forces should be

$$Z_1 = \frac{Z\,s}{r+s} + \frac{U\,h}{r+s}\,;\; Z_2 = \frac{Z\,r}{r+s} - \frac{U\,h}{r+s},$$

where h is the height of the horizontal component at the pin above the point of contact of the rockers on the inclined planes. The co-ordinates r and s are poorly chosen. They should be at some fixed point such as the bottom bearings or at the center between the bearings of the rockers.

The resolution of the forces for the wheel contact with the rail is incorrect. It should be remembered that the friction component has its horizontal component as well.

I think the article meets its purpose very well indeed and should give the majority of your readers an interesting insight as to the nature of the tracking of a locomotive around a curve. The analysis of the factor of wheel bearing has not been sufficiently extended for me to give any further comment on this particular phase.

The Roy diagram offers such a satisfactory method for the real understanding of the tracking of a locomotive, even from a practical point of view, that it is suggested that this method be given consideration.

R. Eksergian,
Baldwin Locomotive Works, Philadelphia, Pa.

The answer

Greenville, Pa.

To the editor:

Relative to the outward reaction of the inner rail on the fourth driver, I formerly held the same opinions as Mr. Eksergian. This reaction was taken into account at the

time of the original investigation in 1919. From the configuration diagrams which we made at that time, and from our analysis of the problem, we were led to believe that such a reaction existed. Since that time, I have frequently noticed that the driving wheels, both in cases of derailment and otherwise, did not line up on the track the way our configuration diagrams showed that they should. I have never seen the flange of the fourth driver in contact with the inner rail although particular pains were taken in various investigations to discover such a contact if there were any. That the inner flanges do not bear against the inner rail is further shown by the fact that on a wye which is used exclusively for turning Santa Fe locomotives, there is not the slightest sign of wear on the inner rail. These observations led to the conclusion that there is no outer reaction of the inner rail on the flange of the fourth driver of a Santa Fe type locomotive. It also shows as a corollary, that the center of rotation is at or ahead of the main driver, for otherwise, the clearance between the fourth inside driver flange would be taken up, which is contrary to fact. The resolution of the forces and the determination of the center of rotation, in our article have been made to agree with our observations of tracking conditions as they actually existed on a certain road.

In regard to the configuration diagrams showing the swing of the engine and trailing trucks to be about equal, I am inclined to think that this is about right. If the swing of the trucks is about equal, the center of rotation must be approximately at the center of the locomotive, that is, if the radius bars are about the same length. Conversely, if the center of rotation is at the center of the locomotive, we would expect the swing of the trucks to be about equal. In the case of the Santa Fe type locomotive, used as an example in the article, the permissible swing of the leading truck is 4½ in. each side of the center, and the permissible swing of the trailing truck is also approximately 4½ in. each side of the center of the truck.

An examination of a number of locomotives of this type revealed that the frames had been severely punished by the trailing truck wheels. They frequently came in from their runs with the frames worn bright. There is nothing to show that the 4½-in. permissible movement of the engine truck is not sufficient. I take these facts to indicate that the swing of the trailing truck is as great as that of the engine truck which simply confirms in another way the conclusion that the center of rotation is at or ahead of the main driver. It is interesting to know that U. S. R. A. 2-10-2B type locomotives do not give any trouble in this respect as they have approximately 8-in. permissible movement of the trailing truck on each side of the center.

Relative to the omission of a consideration of the lateral thrust of the center pin bearing, it is agreed that such a force exists and the omission is acknowledged. This force has been analyzed and used in a number of investigations, but we neglected to take it into account in this instance. This is the force which causes the couple shown in the sketch published in the answer to a question on this subject on page 138 of the March, 1925, *Railway Mechanical Engineer*. However, in reference to the quantities r and s, these are not co-ordinates, but simply moment arms of the vertical force Z which shows that the proportions of Z are resisted by the reactions at different ends of the bolster.

The friction component normal to the side of the rail head was taken into account as well as its vertical component in the resolution of forces for the wheel contact with the rail.

The Roy diagram will give the configuration on the track from the geometrical standpoint from which the flange and hub plays and other characteristics may be easily worked out. But in this case, we have assumed that the tracking is all right and are solving for the nature and intensities of the forces necessary to turn the locomotive against friction. Of course, if a locomotive will not traverse a curve without binding, these forces will be altered in nature and increased in intensity. This, however, is outside of our problem. Flange and hub plays, aside from the fact that they must exist in sufficient degree to prevent binding, do not enter into the case. We are dealing with forces and reactions and the balancing of their moments. The fault that I have to find with the Roy method is that it assumes that the rear axle is radial to the curve, which I believe is erroneous, both from an analysis of the configuration and from actual observation of locomotives on curves. In the case of the Santa Fe type locomotive used as an example, proper tracking by the Roy method would doubtless be shown, but if it had more freedom of trailing truck movement it would be a better curving locomotive.

A proper solution of this problem should be of interest to many railroad men and the criticisms you have made are constructive and should be considered in future investigations.

Roy C. Beaver,
Assistant mechanical engineer, Bessemer & Lake Erie.

Old style hand brake wheels vs. new designs

Mobile, Ala.

To the editor:

It seems that there is an opinion abroad that the time has arrived when the hand brake wheel should be discarded and something new designed to take its place. There are a large number of innovations being put forward and the final outcome will probably be something with decided advantages over the hand wheel now generally used by the railroads.

In the meantime, there are several important points that should be borne in mind. When a hand brake is needed, it is very often more or less a case of emergency, as preventing a car rolling out of the clear, stopping it on an incline, letting it down an incline or for setting a certain percentage of brakes on a heavy train.

Many switchmen and trainmen do not take readily to new mechanical contrivances, and when it is necessary to stop a car quickly, the urgent need is for a brake with which no mistake can be made and which requires no fumbling and fooling in order to understand how to operate it. The old brake wheel certainly meets these requirements. I have asked many trainmen which of the new style brakes they like best. They usually don't know them apart, but often the answer is that some of them are good brakes if you know how to work them. Many trainmen heartily condemn all new styles. One serious objection to most of the new style brakes is that when the end of the car becomes bulged to any extent, the brake shaft supports are thrown out of alinement and it is impossible to entirely release the brake without the use of a wrench or some other similar tool.

The hand brake is too vital a thing to be experimented with extensively. If there is to be a new one it should be adopted and made standard so that all concerned could familiarize themselves with it so that parts could be kept in stock for making repairs, as a defective hand brake puts a car completely out of commission under the Safety Appliance law.

T. J. Lewis,
Car inspector, Southern Railway.

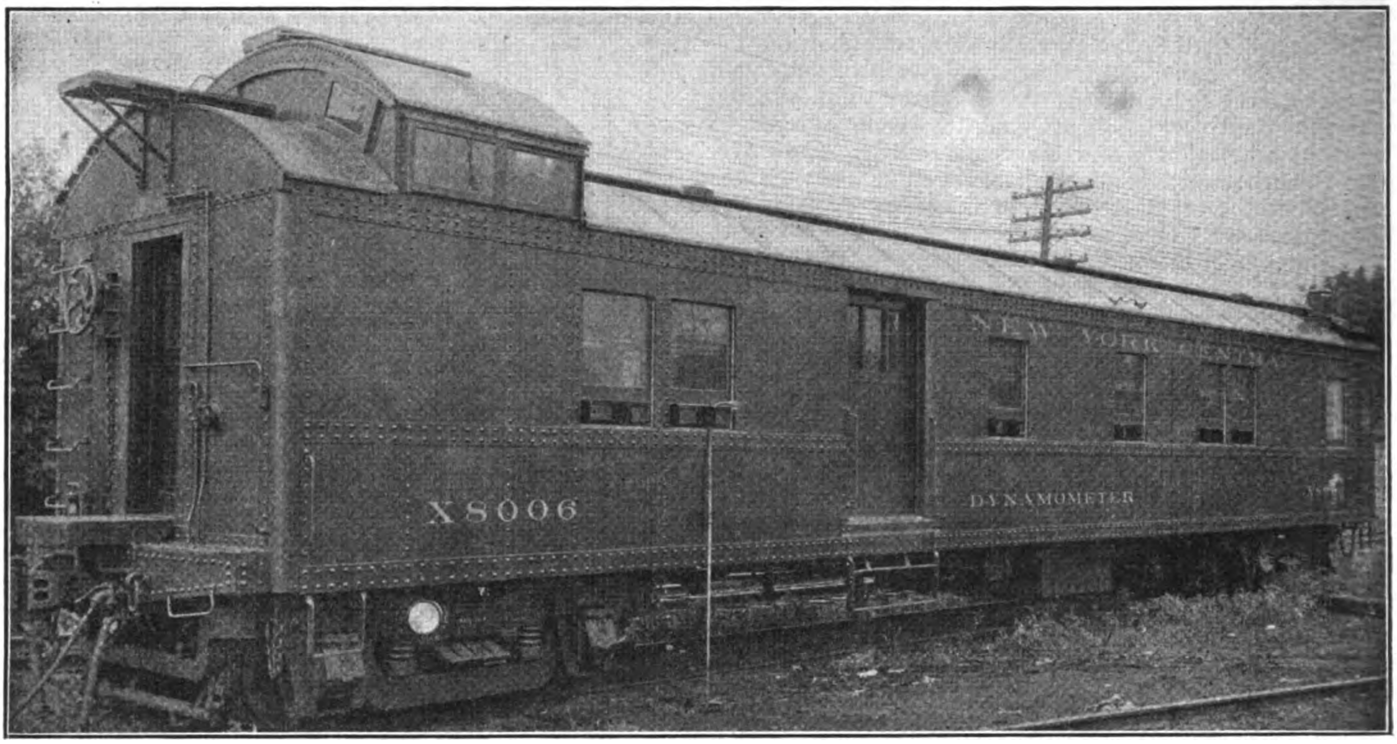
N. Y. C. all-steel dynamometer car

Complete facilities for obtaining a wide range of operating data are provided and conveniently arranged

THE New York Central has had a dynamometer car of all-steel construction in service for something more than a year. The car is unusually well equipped, and its accommodations are well arranged. It was designed under the direction of F. H. Hardin, chief engineer of motive power, New York Central, and the late F. S. Gallagher, engineer of rolling stock, and built at the West Albany shops of the railroad. The dynamometer apparatus was designed, built and installed by the Burr Company, Champaign, Ill.

The car has an inside length of 52 ft. 2-7/16 in. and an inside width of 8 ft. 8⅜ in. The dynamometer or office compartment occupies 21 ft. 6¾ in. of the length of the car, while the remainder is devoted to sleeping and dining accommodations for the crew. As shown in the drawing of the floor plan of the car, accommodations are provided for a crew of seven men and additional accommodations can be provided for two more if necessary. The berth and dining compartment is accessible from both the kitchen quarters and dynamometer compartments. When desired it can be isolated from either end by closing the doors between the sections. Ample toilet, lockers and wardrobe facilities make the car convenient and practical for carrying on the work for which it was designed.

One of the features incorporated into the design of the car is the ⅝-in. steel floor plate which extends over the entire dynamometer end of the car. This plate gives added strength to the frame and assists in taking the high stresses incidental to the measuring of the draw bar pull and buff. Another feature designed for facilitating the work of the crew is the work table which is supplied with reels, interchangeable with those on the chronograph table. It has an approximately length of 12 ft. which permits the operating crew to analyze at one time the record covering a considerable extent of track. Connections to the train air line and brake cylinders are located in close proximity to the chronograph table so that the gages can be easily read. Locomotive steam pressure is carried back to a gage which is also located over the chronograph table.



Dynamometer car built by the New York Central and the Burr Company, Champaign, Ill.

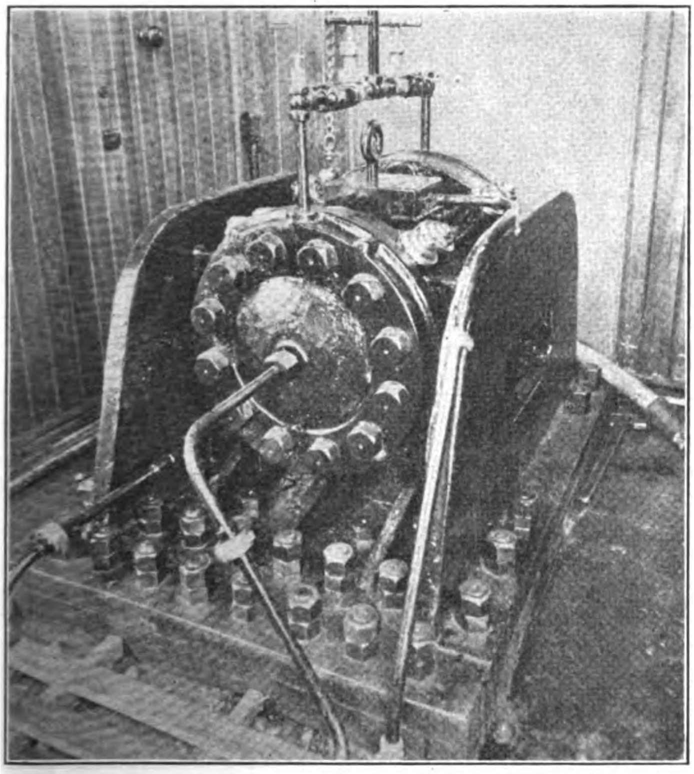
The dynamometer apparatus

The dynamometer has a capacity of 500,000 lb. maximum draw bar pull and a maximum buff of 1,000,000 lb. The apparatus provides facilities for taking 17 graphic records, two of which are for time intervals, which are recorded automatically and simultaneously on the traveling paper ribbon. There are also extra electric recording circuits which may be used for special records when desired. The traveling paper is sufficiently wide so that memoranda may be entered thereon in proper relation to the various graphic records, which are as follows: draw bar pull, draw bar buff train speed, train line air pressure, locomotive steam pressure, brake cylinder air pressure, time intervals, position of the locomotive throttle, locomotive reverse lever position, location of track curves, grades, power delivered through the drawbar to the train, train location, distance traveled, time indicator cards were taken, time and amount of firing the locomotive, and provisions for three unassigned records.

The dynamometer car recording equipment consists of a diaphragm dynamometer, a recording machine, an electric

system which includes only that used in connection with the recording apparatus and an axle drive transmission unit. The electrical equipment does not include that which is used in connection with the car proper.

The draw bar dynamometer consists of a standard draw bar fitted with a special yoke connected to the dynamometer weighing head. The weighing head is designed to receive the full pull or buff from the draw bar and



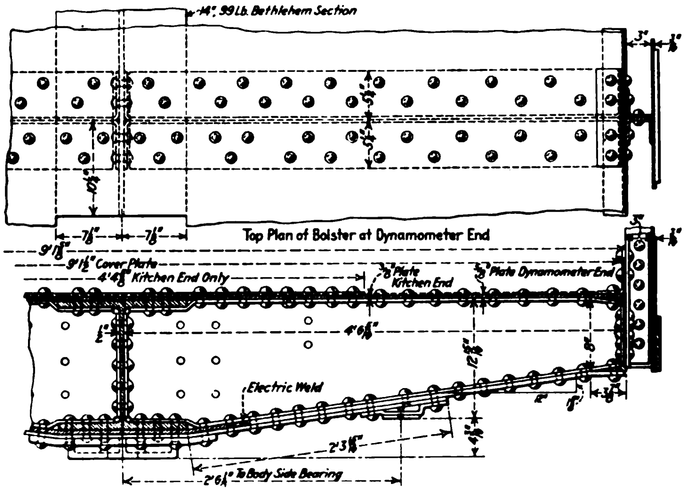
The dynamometer weighing head is designed for a drawbar pull of 500,000 lb. and 1,250,000 lb. buff

transmit the force by means of pistons to pressure cylinders. The forces are here converted into liquid pressure which is transmitted to the chronograph and automatically recorded in proper relation to the time and other records.

The dynamometer weighing head is equipped with locking devices for holding the piston inactive so that the car may be moved in an inoperative condition. It is mounted on the ⅝-in. steel floor plate in a rigid position so that it can take and record the maximum pull and buff without vibration or damage from sudden shock. The weighing head is also equipped with limit alarms to insure the floating action of the pistons. Special indicators are used for recording the draw bar pull and buff records. These are provided with a full set of reaction springs which cover the entire range of operations for which the car is designed.

The chronograph makes all of the records simultaneously on the traveling paper ribbon without interference or space corrections, with the exception of the five magnet records, which are placed back of the straight line chronograph record. The movement of the paper ribbon can be proportioned to the distance traveled or it can be run at a constant speed as desired.

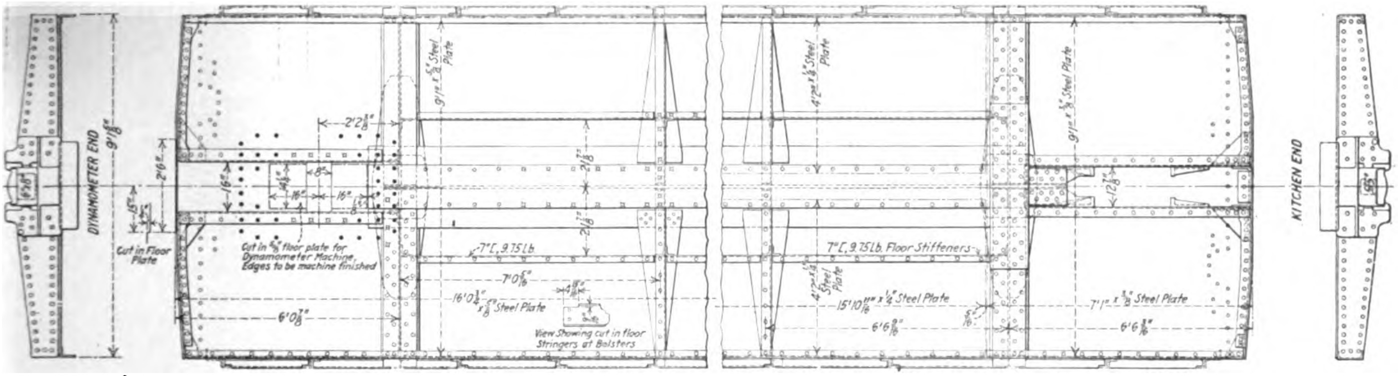
Special pens are used for each chronograph recording instrument mounted on a rigid supporting arm which is controlled by the testing instruments. All the instruments, together with the indicating gages and magnet control circuits, are placed in such a manner as to be readily accessible to the operator, so that he may readily observe and control the chronograph record and make necessary memoranda on it.



Drawing of the body bolster at the dynamometer end

The driving transmission

The driving transmission includes a clutch control equipment for shifting the driving mechanism from the car trucks to an electric motor operated from the train line battery. It also includes the shift gears for changing the travel ratio of the paper ribbon and provides an automatic reverse drive clutch so that the paper will always travel forward regardless of which direction the car travels. The transmission gears are enclosed in a dust proof oil case of rigid construction. Bevel gears are used for connecting the drive to a telescopic torque shaft con-

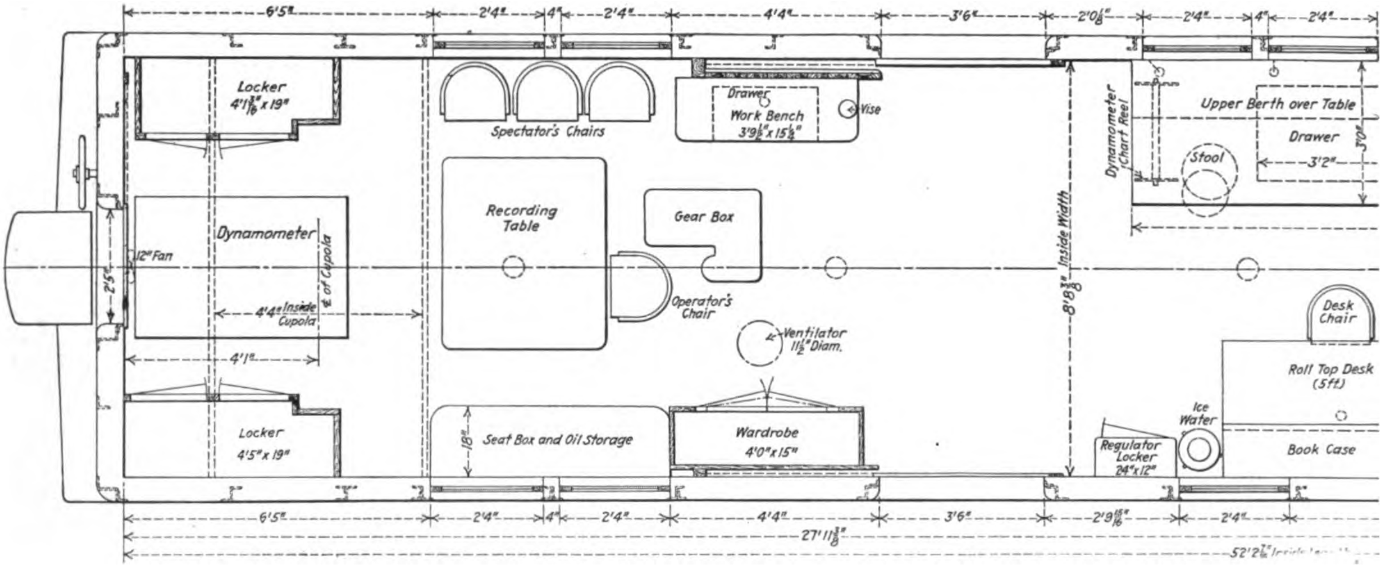


Underframe of the New York Central dynamometer car

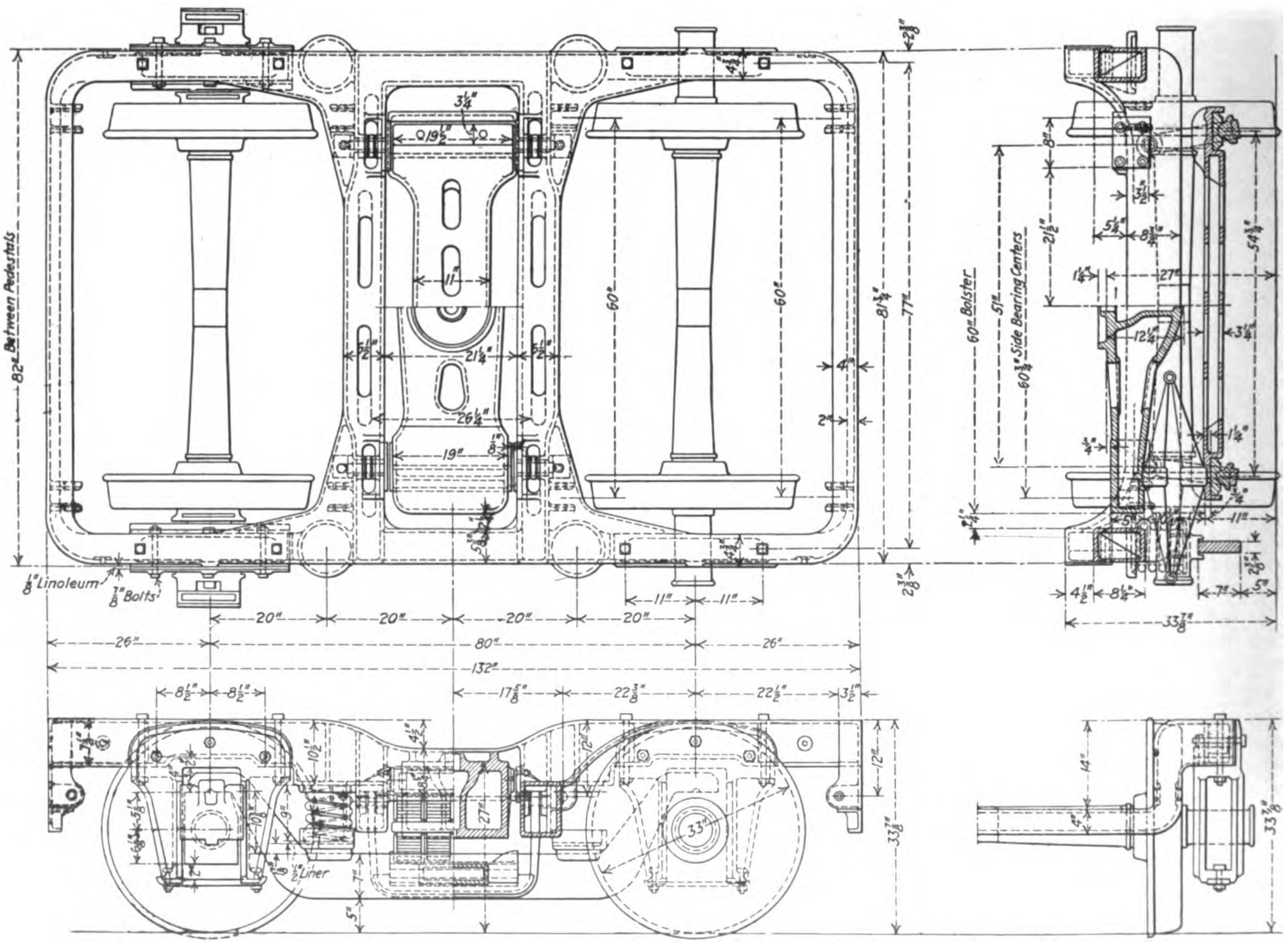
nected to the rear axle of the forward truck under the dynamometer end. This drive on the forward truck is also mounted in a dust proof gear case and is provided with a disengaging clutch for disconnecting the entire gearing system when the car is being moved in an inoperative condition.

The distance timer, which is on the transmission unit, makes automatic electric contact for every 100 ft. of train travel. A constant speed motor is used for the speedometer as well as for the purpose of keeping the paper in motion when the car is at rest. All the transmission levers, the motor rheostat and switches for the entire apparatus are located within easy reach of the operator.

The kitchen is located at the opposite end of the car from the dynamometer compartment, as shown in the floor plan. It is equipped with a range, refrigerator,

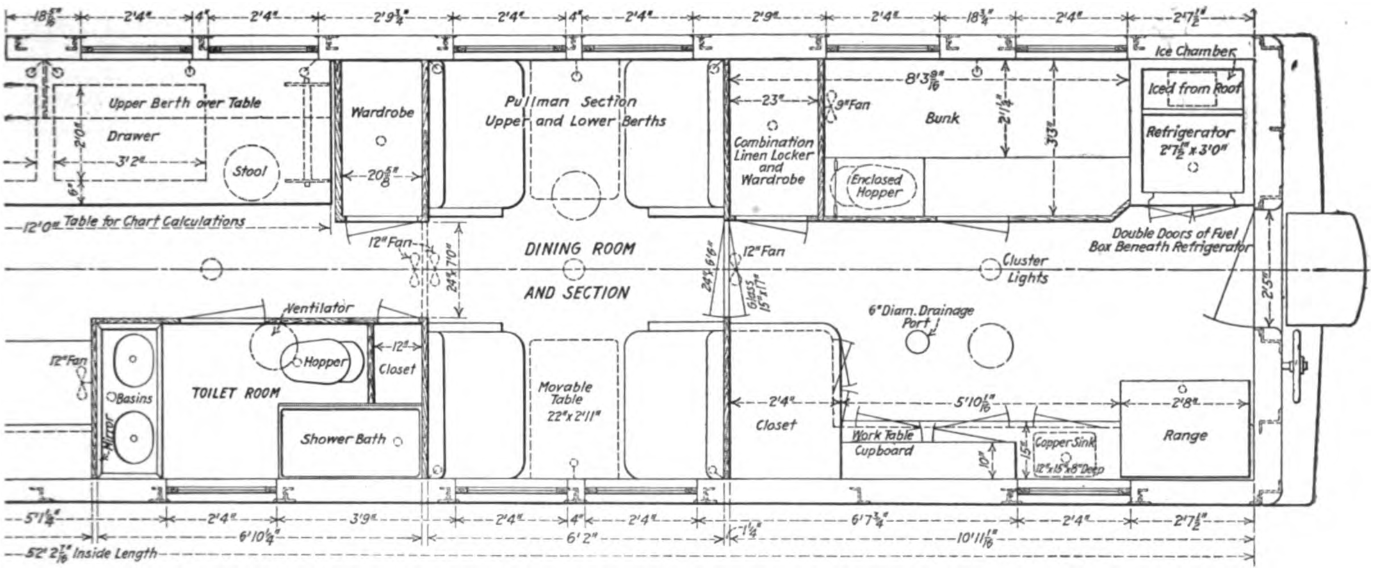


Floor plan of the dynamometer



The trucks are of the equalized type, with cast steel frames and bolsters

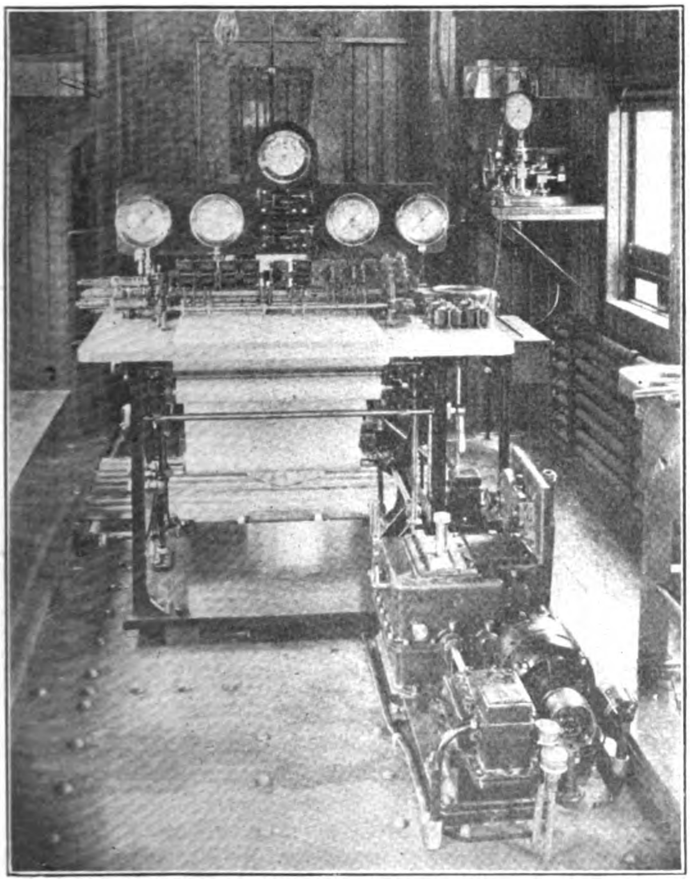
copper sink, work table with cupboards above and below, china closet, a fuel box which is located beneath the refrigerator, combination linen locker and a wardrobe compartment equipped with a bunk and enclosed hopper for calculations. The equipment in this section also includes file cases, stools, dynamometer chart reels, two upper berths, a roll top desk and chair, a bookcase and water cooler stand, drinking cup container and a wardrobe and



car built by the New York Central

the use of the porter who takes care of the car service.

The dining room section is provided with two Pullman sections of upper and lower berths and two removable tables. The section between the dining room and side doors, which is shown in one of the illustrations, is provided with a table, equipped with two drawers, for chart



The dynamometer recording apparatus with the traveling paper in position ready for operation

closet. The section between the side doors and the dynamometer end of the car is provided with a work bench, gage tester, gage board, vise, instrument board, chairs for spectators, lockers, recording table, dynamometer, and a chair for the operator.

Special features

The car is heated with the vapor system and is ventilated by means of five 6-in. Globe ventilators. The sides, end walls, cupola and roof sheets are insulated with a ½-in. thickness of special hair felt, applied next to the outside sheathing. Three ply hair and asbestos insulation is applied over the entire surface of the steel floor plates and to the inside surface of the outside sheathing and the under side of the bottom course of the flooring.

General data and dimensions

Maximum draw bar pull	500,000 lb.
Maximum buff	1,000,000 lb.
Length, inside	52 ft. 2 1/16 in.
Length over platform end sills	55 ft. 0 1/16 in.
Length, center to center of trucks	42 ft. 5 in.
Truck wheel base	6 ft. 0 in.
Width over side sills	9 ft. 1⅝ in.
Width over all at eaves	10 ft. 0⅞ in.
Height, top of rail to the top of roof carlines	12 ft. 6 3/16 in.
Height, top of rail to the top of running board over cupola	14 ft. 8 in.
Height, top of rail to the top of floor	3 ft. 11⅝ in.
Height, maximum, top of rail to center of coupler	2 ft. 10½ in.
Height from underside of the side sill to the top of side plate	7 ft. 6¼ in.
Width, inside of car	8 ft. 8⅜ in.
Height, inside of car (at center)	8 ft. 3⅝ in.
Width of door opening, one each side	3 ft. 6 in.
Width of end door opening	2 ft. 5 in.
Length of center sill	44 ft. 9¾ in.
Thickness of bottom cover plate	0 ft. ½ in.
Size of belt rail	5 ft. by ¼ in.
Size of side plate angle	5 in. by 3 in. by 5/16 in.
Thickness of sheathing above the belt rail......Angle	0 ft. 3/16 in.
Thickness of sheathing plate below the belt rail..Angle	0 ft. 3/16 in.

Current for the lighting equipment is supplied from a three-kilowatt low speed generator operated from the car axle. The lighting equipment can also be operated on battery discharge on layovers up to eight hours.

The water supply is contained in two overhead water tanks, located in the kitchen, one on each side of the car and formed to the contour of the roof. Each tank has a capacity of 100 gallons. These tanks can be filled simul-

taneously from the ground on either side of the car or from a filling opening in the roof. The tank on the range side of the car is used for hot water which is heated in pipes passed through the range. Additional heating facilities are also provided by the use of a steam jacket which surrounds two of the radiator pipes on the range side of the car. The sink basins and shower are provided with supply pipes for hot and cold water.

Every possible short cut for saving time and labor in the final computations has been incorporated in the design and operation of the car. A special method has been provided for integrating the area under the draw bar pull curve. Special devices designed to protect the delicate instruments from unnecessary vibration and shock have been provided. When the liquid in the dynamometer cylinder becomes dangerously low, an electric contact is made automatically, which rings a warning bell. The entire design of the machine is dependent throughout on line contact and is, therefore, quite free from friction. The piston movement for the maximum draw bar pull is .006 inch. Every provision possible has been made to eliminate the effect of friction and the weights of the various parts have been reduced as much as possible in order to decrease the effect of inertia. In order to facilitate the work of compiling data the speedometer is geared so that the height of the speed curve taken in passenger traffic is double for that taken in low speed freight traffic.

The principal feature of the car is the large number of records and miscellaneous information which can be taken, relating to successful train operation. This information can be so arranged that it will not only be of value to the Motive Power Department, but to the various other departments as well.

Locomotive feedwater heating*

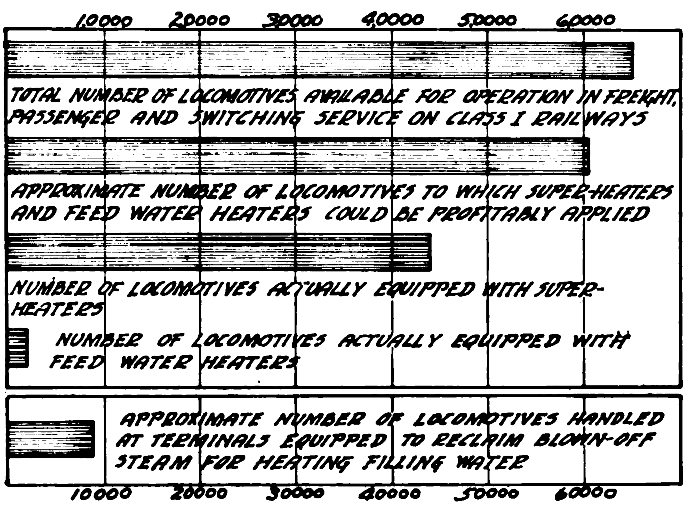
Proper methods of testing important—Building up feedwater temperature and boiler pressure by direct steaming at terminals

By L. G. Plant

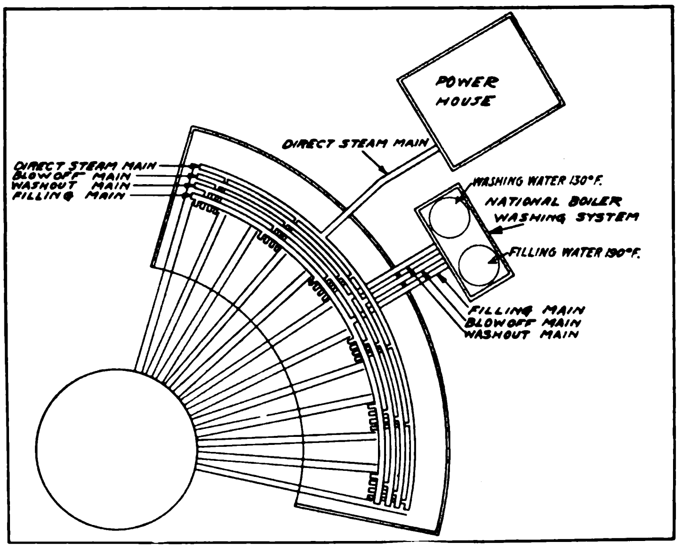
Assistant to president, National Boiler Washing Company, Chicago

RECENT developments in feedwater heating represent the most fundamental improvement to locomotive economy since the advent of superheating. The application to railway motive power of a long established practice for feedwater heating in stationary power plants is only another belated response to the same economic cause that led to the introduction of superheated steam and other revolutionary changes in locomotive practice.

Each of the several types of feedwater heaters afford so practical a means for applying to locomotive operation a practice that has long been regarded essential in every efficient stationary power plant that it is difficult to understand why the application of this equipment has been so retarded. Aside from the inertia that accompanies every departure from accustomed practice, there are certain features in the application, operation and maintenance of live steam injectors that exert a strong hold on locomotive practice, so admirable is this device adapted to its requirements. From the standpoint of reliability in service, simplicity in operation and ease of maintenance, there is no locomotive water feeding device comparable with the live steam injector.



Proportion of locomotives equipped with superheaters and feedwater heaters



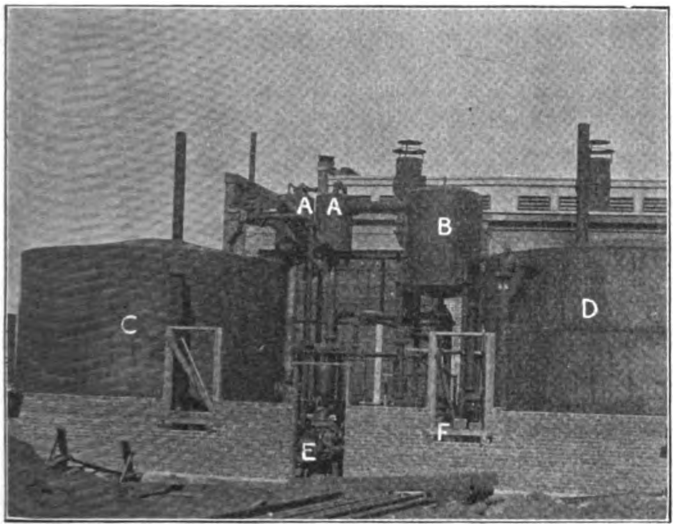
Plan of enginehouse designed to provide direct injection of live steam and hot filling water into the locomotive boilers

Testing methods can be improved

Another factor that has retarded the development of locomotive feedwater heating is the lax and indecisive testing methods to which the application of this equip-

*Abstract of an address at the February meeting of the Central Railway Club, Buffalo, N. Y.

ment is frequently subject. The speaker recalls that about ten years ago he had occasion to investigate the performance of a Caille-Potonie feedwater heater that had been tested on a southeastern railroad some years prior. This is a closed type of heater which was developed in France many years ago and is now extensively used in that country. One of the directors of the American railroad had become interested in the possibilities of such equipment and a heater of this type together with the pump and accessory apparatus had been imported for test on the railroads in this country. The only record of this test disclosed in the files was a report to the superintendent of motive power to the effect that the



A-A—Twin condensers; B—Separator; C—Washout tank; D—Filling tank; E—Washout pump; F—Filling pump.

Boiler washing and filling system in the process of erection

road foreman had made two round trips on the locomotive and had not noticed any improvement in performance due to the application of the feedwater heater. As a result of this exhaustive test the apparatus was dismounted from the locomotive without further investigation and shipped back to France. "Tests" of this general character have cost American railroads a good many millions of dollars.

It is significant that railroads on which the most exhaustive tests of locomotive feedwater heaters have been made are now becoming the most extensive and consistent users of this equipment. There is no lack of authentic data on the performance of locomotive feedwater heaters available to any railroad that is not in a position to make exhaustive tests of this device. In fact, the technical aspects of locomotive feedwater heating are no longer problematical. Tests to determine the practicability and value of this practice are as out of date as similar tests of the superheater. On matters other than maintenance, the relative efficiency of types and improvements to existing equipment, etc., sufficient data is already available and the question of applying feedwater heaters is entirely an economic problem.

Where tests are made, it is particularly important in the case of the locomotive feedwater heater to concentrate attention upon those factors that are strictly relative to the actual value or relative merits of this equipment. Otherwise, the real issues involved may be obscured by a mass of irrelevant data and over-all generalities. The first consideration is that of temperatures attained by water in relation to the temperature of exhaust steam available for heating. Next comes the cost of maintaining this equipment with particular reference to the facilities available for this purpose.

The most important operating characteristic of a locomotive feedwater heater is the temperature at which it can deliver feedwater to the boiler. The economy from feedwater heating increases with each degree rise in temperature of the water delivered to the boiler. Under the conditions usually assumed for locomotive operation, every 12½-degree increase in feedwater temperature accomplished by waste heat represents an increase of one per cent in the steaming capacity of the locomotive. [Mr. Plant here showed curves representing a record of both the feedwater and exhaust steam temperatures observed at different rates of evaporation in the Pennsylvania tests of a decapod type locomotive equipped with an open-type feedwater heater.—Editor.]

The gain in locomotive efficiency by feedwater heating can be determined from these temperatures after the heat content in steam used by the pump has been deducted and the effect of any reduction in back pressure on account of exhaust steam diverted to the feedwater heater has been credited to its performance. No tests of this equipment are complete without a complete record of exhaust steam and feedwater temperatures, a measure of the steam used by the pump and a determination of the back pressure at given cut-offs with and without the feedwater heater in operation.

A partial record of the feedwater and exhaust steam temperatures in the test of a Canadian National Mikado

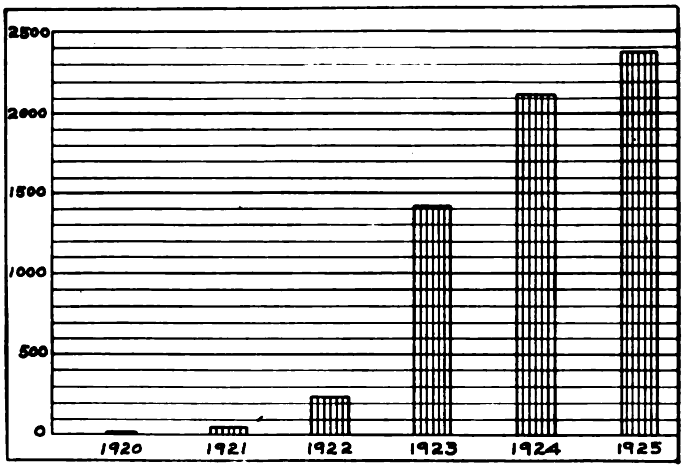


Chart showing yearly growth in the number of heaters in service

type freight locomotive equipped with a closed-type feedwater heater is illustrated.

Feedwater heating at terminals

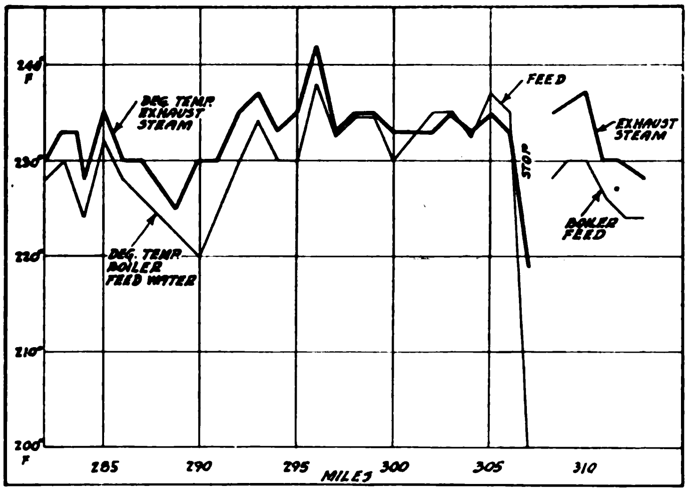
A consideration of the situation at all important locomotive terminals will further enlarge our conception of the realities and possibilities of locomotive feedwater heating. It is estimated that approximately 20 per cent of all locomotive fuel is consumed at terminals. A considerable part of this fuel is consumed in firing up locomotives and the amount required for this purpose depends upon the temperature of the water with which the locomotive boiler is filled. The law requires all boilers to be emptied and washed at least once each month and on many railroads operating conditions necessitate refilling boilers much more frequently. Equipment for washing and filling locomotive boilers with hot water has been generally regarded as merely a convenient maintenance facility.

With the emphasis that is being placed on the economy of feedwater heating on the road, it is only appropriate to direct attention to the fact that it requires about 1,200 lb. less coal to fire up a modern locomotive filled with water

at a temperature of 180 deg. than when the locomotive boiler has been filled with cold water. If the heat required to elevate the filling water to this temperature is reclaimed from the heat content of steam blown off from incoming locomotives, this reduction of 1,200 lb. coal in the quantity of fuel required to fire up the locomotive represents a true saving. One of the illustrations shows the equipment required to obtain this economy, indicating the separator into which the blown-off water and steam from incoming locomotives is first discharged. The water gravitates to the washout tank from which it is drawn for boiler washing purposes. The exhaust steam flows to twin condensers of the jet type, and here again we have an application of the principle involved in the operation of the open-type feedwater heater. Fresh, cold filling water flows to the reservoir from which it is drawn for filling locomotive boilers at temperatures ranging from 180 to 210 deg. Higher delivery temperatures are not practical since the system is operated at atmospheric pressure.

Building up boiler pressure by direct steaming

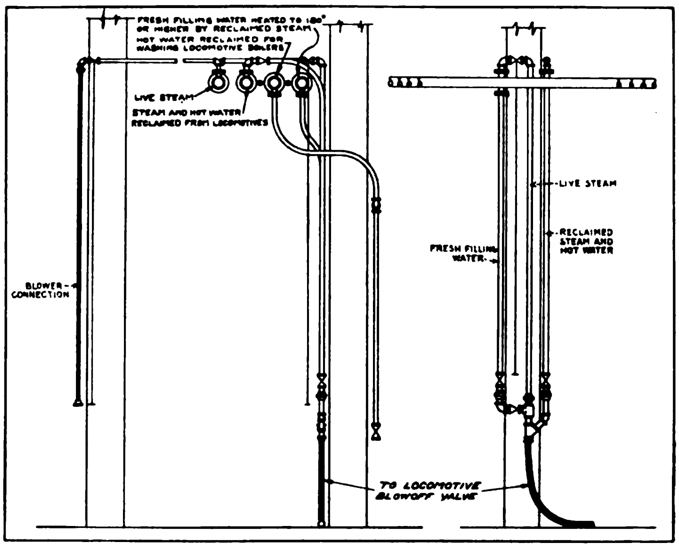
Tests recently conducted on a western railroad develop the fact that for each 20-deg. increase in the temperature at which the locomotive boiler is filled there is a saving of about 8 gal. of oil or its coal equivalent in the quantity of fuel and approximately 10 min. in the time required to fire up a large Mikado type locomotive. These tests, however, are related to a new and even more significant aspect of locomotive feed water heating at terminals. This is the direct injection of live steam and hot filling water by means of the system of mains shown in one of the drawings. The use of live steam drawn direct from a stationary power plant as indicated together with hot filling water, enables a locomotive to be filled and steamed



Temperature record with Elesco feedwater heater on Canadian National 2-8-2 type locomotive

up to a pressure approximating the stationary boiler pressure without lighting the fire in the locomotive firebox. The time required for this operation is about the same as in the usual procedure, but there is a gain in efficiency due to the elimination of the houseblower which ordinarily consumes steam at the rate of 40 boiler hp. per hour or higher. Furthermore, steam supplied from modern stationary boilers can be more efficiently generated than in a locomotive boiler during the firing up stage so that there is a further gain in efficiency on this account. The elimination of smoke and of blower steam within the enginehouse are factors of no little importance. The operation of smokeless enginehouses in which all locomotives are steamed up by this method can be anticipated. In this case all fires would be dumped before locomotives are placed in the house and the fires are not lighted until the locomotive is placed in a firing-up shed adjacent to the enginehouse.

The enginehouse pipe connections required for this method are illustrated. These provide a live steam drop in connection with the hot filling water main and a blow-off connection. In filling a locomotive both the live steam and filling water valves are opened and the boiler filled through the blow-off valve with this mixture of steam and water. As soon as the water shows in the glass it is shut off and the steam allowed to flow into the boiler until the desired pressure is built up. With this arrangement, it is possible to hold locomotives under a working steam pressure. If the fire is lighted as soon as the water shows in the gage glass, the time required to fill and steam up



System of drops for direct steaming of locomotives without fire on the grates

modern locomotives to a working steam pressure can be reduced to approximately half an hour.

The largest factor for increasing locomotive output may be anticipated in the form of facilities for increasing the percentage of time that locomotives are available for active service. This will come in the form of better equipment for maintaining motive power and turning it rapidly at terminals. Not to exceed 9,000 locomotives are now being operated through terminals having modern equipment for filling boilers with hot feed water heated by blown-off steam. The installation of this type of feedwater heating equipment at all large locomotive terminals would add the equivalent of approximately 1,700 locomotives to the power available for service.

This enlargement in motive power capacity will be accompanied by a reduction in fuel consumption of corresponding proportions so that the outlook for locomotive feed water heating is truly a great prospect.

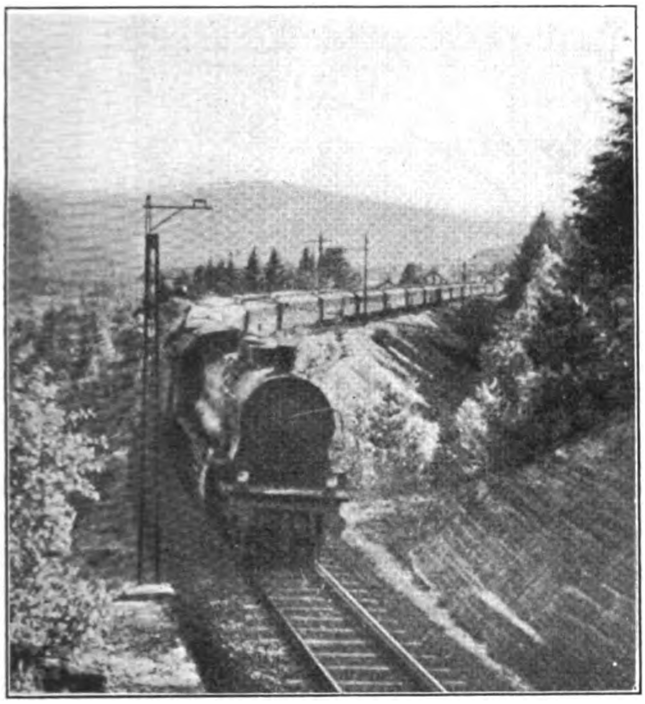
A NEW MOTOR CAR and trailer, built by the Sykes Company, St. Louis, and the St. Louis Car Company, St. Louis, Mo., has recently been delivered to the Boston & Maine. It is planned to place this train in operation between North Adams, Mass., and Troy, N. Y., about March 15. The motor car is 51 ft. over all, comprising a 16-ft. baggage compartment and accommodations for 30 passengers. It is equipped with a Sterling, six-cylinder heavy duty gasoline engine developing 225 hp. The trailer is of the vestibule type and is 45 ft. 6 in. over all and has a seating capacity of 52 persons, making a total of 82 passengers for the train. This is the third motor car unit to be placed in operation on the Boston & Maine.

German State Railway's brake tests

Comparative tests are made with the Westinghouse and Kunze-Knorr types in order to obtain shorter braking distances

London. Eng.

THE first of a series of train brake tests conducted by the German State Railways were inaugurated in March, 1924, and were carried through the year until the latter part of September, when a test train of 23 vestibule coaches was made up and run on September 27, 1924, in connection with the Engineers' Meeting at the Berlin Railway Exposition. The object of the experiments was to determine the efficiency of the Kunze-Knorr brake on express, passenger, freight and mixed trains. It was at first desired only to determine as to what extent the weight and speed of express trains could be so that increased speeds would be possible. The distance between the warning signal and home signal on the main line averages about 2,297 ft. The speed, therefore, depends to a large extent on the ability of the engineman to bring the train to a stop within that distance. The engineers who conducted the tests reported that it was possible to bring the average express train to a stop within this distance with the Kunze-Knorr apparatus from an initial speed of 74.5 miles an hour, as compared with an initial speed of 65.25 miles per hour with the type of Westinghouse quick-action brake used in Germany.



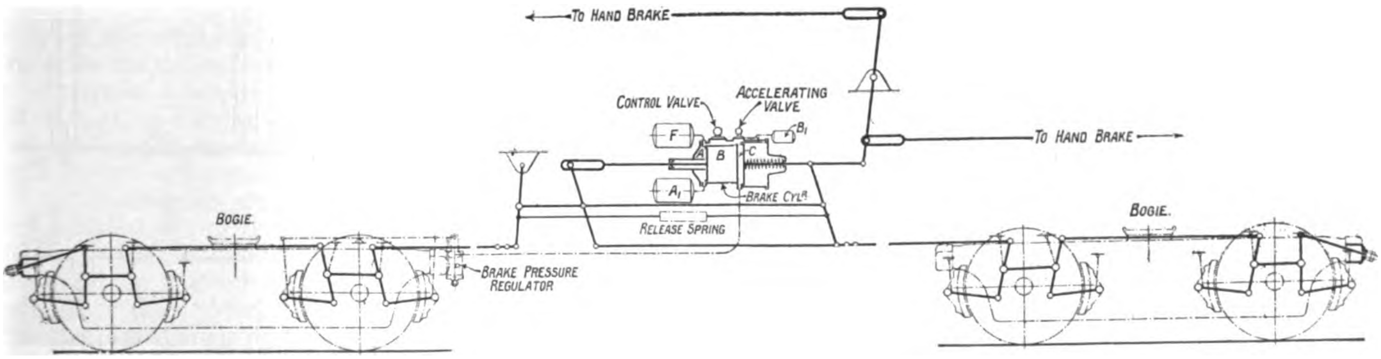
Test train used for the trial runs made during the Berlin Railway Exhibition

A profile of the section over which the trials were made is shown in one of the drawings. The dimensions shown are in the metric system. As will be noted, a number of sharp grades are encountered between Wannsee, a station near Berlin, and Belzig which made this section of track ideal for conducting brake tests. All of the grades, however, were negotiated with the original power until the trains reached Baitz. Pusher service was furnished at this point to take the train up a 2.03 per cent grade to Belzig, which is the ruling grade for the section over which the tests were run.

Results of the second test in which Westinghouse brakes were used

Out of the total of seven trial runs reported, the second run was the only one in which the Westinghouse brakes were used, and even in that test, they were not used exclusively but were in a train which also contained Kunze-Knorr express, passenger and freight type brakes.

The train used in the second run consisted of a ten-wheel type locomotive and 17 cars, which had a total of 52 axles. Of this number 47 axles, or 90 per cent of the total, were braked. Of the 17 cars composing the train, three passenger cars, having two four-wheel trucks, were equipped with the Kunze-Knorr express brake; three four-wheel passenger cars had the Kunze-Knorr passenger brake; four six-wheel passenger cars and three passenger cars having two four-wheel trucks, were equipped with the Westinghouse quick-acting brake; and three four-wheel box cars were equipped with the Kunze-Knorr freight



Layout of the foundation rigging of the Kunze-Knorr air brake as applied to a passenger car on the German State Railways

safely increased, but while these trials were still in progress, the increase in freight traffic created a demand for an air brake suitable for freight service.

Operating conditions also called for a brake that could stop trains in shorter distances than previously required brake. A dynamometer car, an interior view of which is shown in one of the illustrations, was attached to the rear end of the train. This location was chosen for all seven trials on account of the fact that shocks due to braking are more severe at the rear end of the train than

at the front. The dynamometer car was equipped with two four-wheel trucks.

The maximum braking power on the three passenger cars equipped with the Kunze-Knorr express brake was 127 per cent of the total car weight at the beginning and 85 per cent at the end of the stop. In the case of the

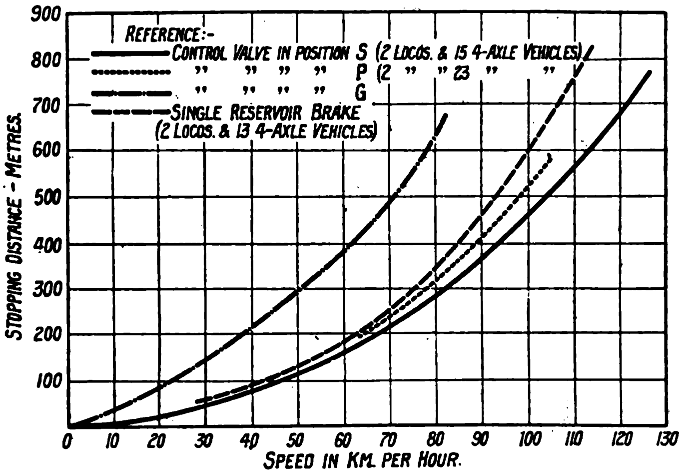


Chart showing the stopping distances for emergency applications made while running on level track

four-wheel passenger cars equipped with the Kunze-Knorr passenger brake, a maximum braking power of 80 per cent of the total car weight was obtained. The Westinghouse quick-acting brake on the six-wheeled passenger cars recorded a maximum braking power of from 55 per cent to 60 per cent of the total weight of the car. This equipment also recorded a maximum braking power of from 77 per cent to 84 per cent of the total weight on the braked wheels of the three passenger cars, while 75 per cent was the average obtained on the three four-wheel box cars equipped with the Kunze-Knorr freight brake, or 56 per cent of the total weight.

The total weight of the cars in this train amounted to 435 tons. The total weight, including the locomotive, was 536 tons. The maximum brake shoe pressure exerted on the wheels of the train was 442 tons, giving a percentage of brake shoe pressure to the total weight of the train of 83 per cent.

The sixth trial run was the only other test made with mixed equipment. This train, however, had a total of 54 cars with 120 axles hauled by two ten-wheeled type locomotives. Of this number only 75 axles or 62.5 per cent were braked, which does not give sufficient data to make a comparison between the second and sixth tests to ascertain the relative merits of the two brake systems. All of the cars used in the sixth test had Kunze-Knorr brakes. The fifth and seventh test trains were composed entirely of passenger equipment, while the third and fourth test trains were composed of express, and passenger and express equipment, respectively. The first test train,

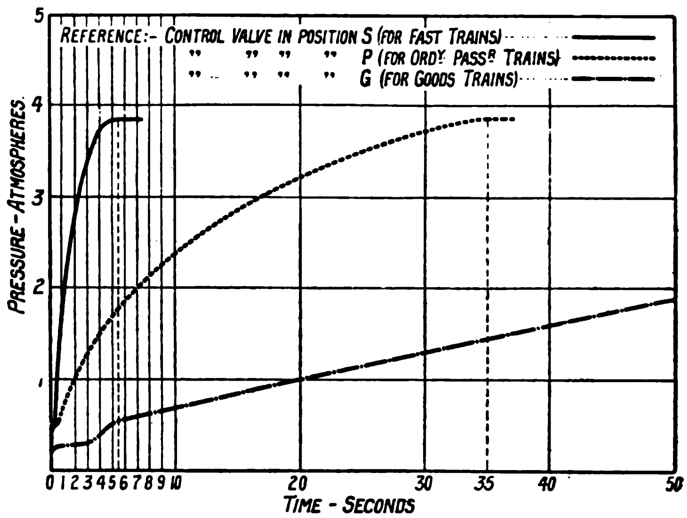


Chart showing the increase in pressure (in atmospheres) for different positions of the Kunze-Knorr control valve

which was run March 11, 1924, consisted of freight equipment.

Referring to the statement made in a preceding paragraph, in which is given the initial speeds from which a train can be stopped in 2,297 ft., the average braking power required for the Kunze-Knorr brake between the wheel and the rail must, therefore, be approximately

$$\frac{65.25^2}{74.5^2} = 1.3 \text{ times as great as that of the Westinghouse}$$

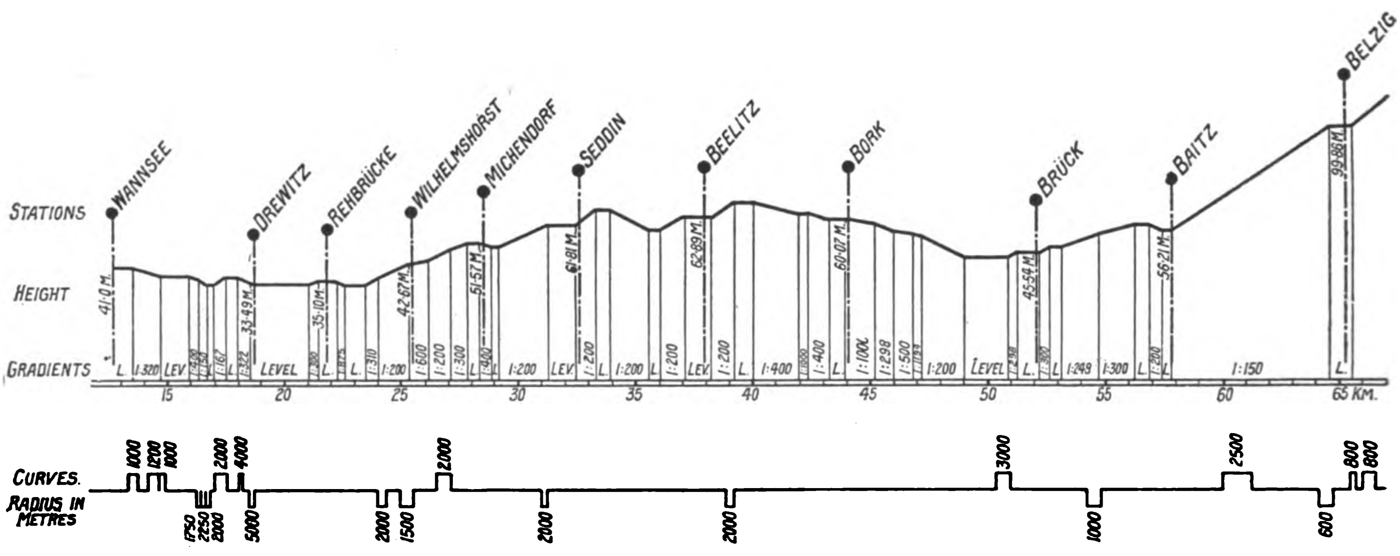


Diagram showing the profile of the track over which the tests were run (distances are shown in kilometers, grade ratios in meters)

brakes, which are at present used on the German State Railways. During the seventh test, a description of which was published in the October 24, 1924, issue of *The Railway Gazette*, London, Eng., the brake shoes of one of the cars, which weighed about 41 tons, were pressed against the wheels with an approximate pressure of 1.3 times the weight of the car, making a total pressure of about 54 tons. While the speed decreases, the coefficient between the brake shoes and the wheels increases and this pressure must be reduced towards the end of the braking distance or the wheels will skid. This factor has been taken into consideration in the design of the Kunze-Knorr brakes, skidding being prevented by

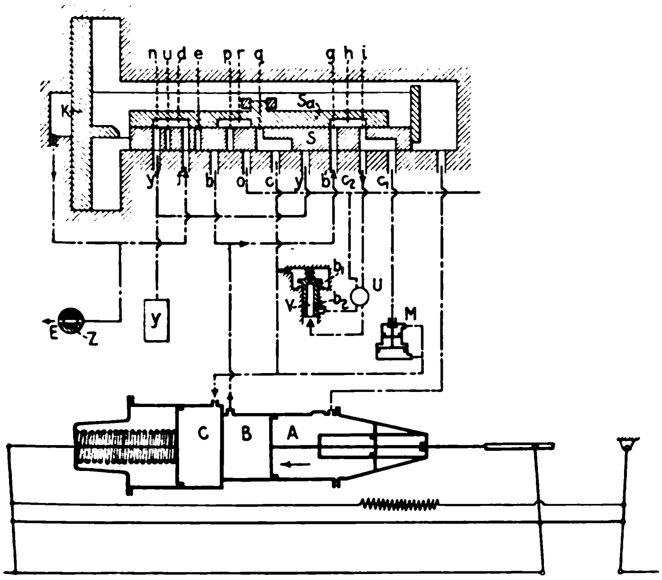


Fig. 1—Diagram showing the arrangement of the Kunze-Knorr brake for freight trains—Triple valve in service position

a pressure regulator *M*, referring to Fig. 1, which is a part of the equipment on each car. This regulator, as soon as the braking power exceeds the given maximum, allows the air to escape from a single-chamber brake cylinder.

The Kunze-Knorr brake

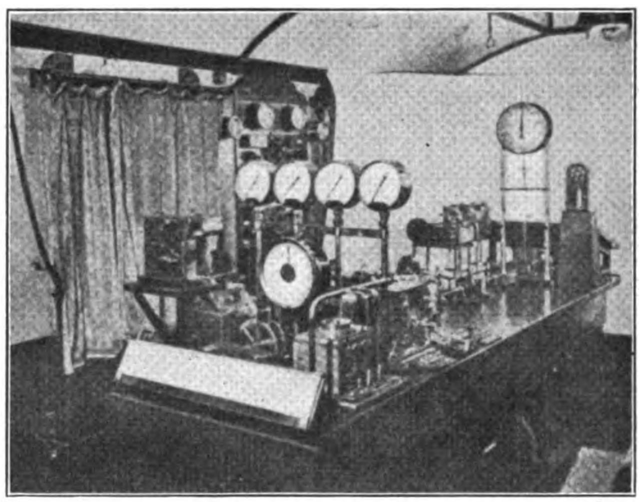
As described by the manufacturers, the Kunze-Knorr brake is an automatic air brake which embodies all the features of the Westinghouse brake in use in Germany combined with a differential brake cylinder which, it is claimed, affords flexibility in braking and a high degree of safety. The designers of the Kunze-Knorr brake have combined the semi-automatic brake, or one-chamber system, with the differential brake, or two-chamber system, which permits graduating the release of the brake.

Referring to Fig. 1, quick propagation of the braking effect throughout the length of a freight train in order to obtain smooth stops is obtained by the propagation pocket *Y*, which is made an integral part of the triple valve body. The restricted size of this pocket limits the brake-cylinder pressure at the first service application by taking up the amount of air pushed forward into the brake valve *K* by the triple valve piston. The direction of air travel from *K* to the propagation pocket *Y* is shown by the arrows. As the triple valve piston moves forward, the ports *y* and *f* are uncovered by the ports *n* and *d*, which permits a direct passage from *K* to *Y*. As the triple valve piston moves forward, it accelerates the action of the compressed air in the brake pipe *E*, which induces increasing pressure and the train comes to a stop. *Z*, which is shown located in the brake pipe, is the isolating cock.

In order to eliminate the shock and dangerous stresses occurring in the handling of long freight trains, the pressure control valve *M* has been inserted in one of the two air passages between the triple valve and the brake cylinder *C*. When the brake is being applied at first, compressed air from the chamber *B* is passing into the brake cylinder *C* through the throttled port $c2$ and the larger port $c1$, which leads through the pressure control valve *M*. But as soon as a pressure of about 10 lb. has been reached, the double piston in the pressure control valve *M* closes so that any further rise of brake cylinder pressure is comparatively slow, depending on the amount that the port $c2$ is throttled.

The double or differential piston cannot exert any braking effect as long as the same air pressure is acting upon either side of the piston. The control valve *V* being located in the passage between the triple valve slide valve *S* and the brake cylinder the connection between the two chambers *B* and *C* is intercepted as soon as the pressures have equalized so that the spring on top of the valve *V* forces the valve down on its seat. Any further reduction in brake pipe pressure connects the chamber *B* with the atmosphere by the uncovering of the ports *b* and *o* by *p* and *q*, so that this chamber is vented and the full pressure in chamber *A* is acting upon the differential cylinder which increases the braking power accordingly. This additional braking force is used in the Kunze-Knorr system to provide the necessary braking power for loaded cars. Thus, the same approximate braking ratio is available for empty and loaded cars.

The passenger and express equipments are each



Interior view of the dynomometer car, showing the recording apparatus

provided with an accelerating valve designed to increase the speed of the propagation in order to obtain a smooth stop in a short distance from relatively high speeds. The three designs of the Kunze-Knorr brake apparatus are essentially the same. The apparatus may be made applicable to the three different types of service by moving the handle of the change-over cock *V* to one of three positions.

It may be of interest to call attention to the type of draft gear with which the coaches used in the trial runs were equipped. The friction buffers, similar in general appearance to the European style of equipment, applied to these cars were what is known as the "Uerdingen" type which is designed primarily to absorb heavy shocks. It is of the friction type which releases slowly after being compressed.

A dynamometer car was used in all of the trial runs,

the tests comprised emergency and ordinary service stops from both high and low speeds. Records of the speed in kilometers per hour were taken at different points where the train made a test stop, or reduced speed. A profile map of the section over which the trial runs were made, was mounted in the dynamometer car below the speedometers in such a position, as to make it comparatively easy to verify the speeds at a glance on up and down grades and on the level. Both telephone and electrical communication were established between the locomotive and dynamometer car. In order to determine the figures of retardation, a meter of new design was used which directly recorded the retardation figures during braking in meters per sec^2. The speedometers were also driven from the same measuring axle as that of the brake distance meter. The temperature of the brake shoes was measured by a pyrometer connected to thermo-elements screwed into the brake shoes.

Various service applications were made during the tests with the idea of duplicating as closely as possible the ordinary conditions of passenger train operation over the same section of track. A number of emergency applications were made from the dynamometer car. The engineman being entirely unaware of the moment at which the emergency application was to be made. A number of service applications were also made from various speeds.

Eight-wheel switchers for the D. T. & I.

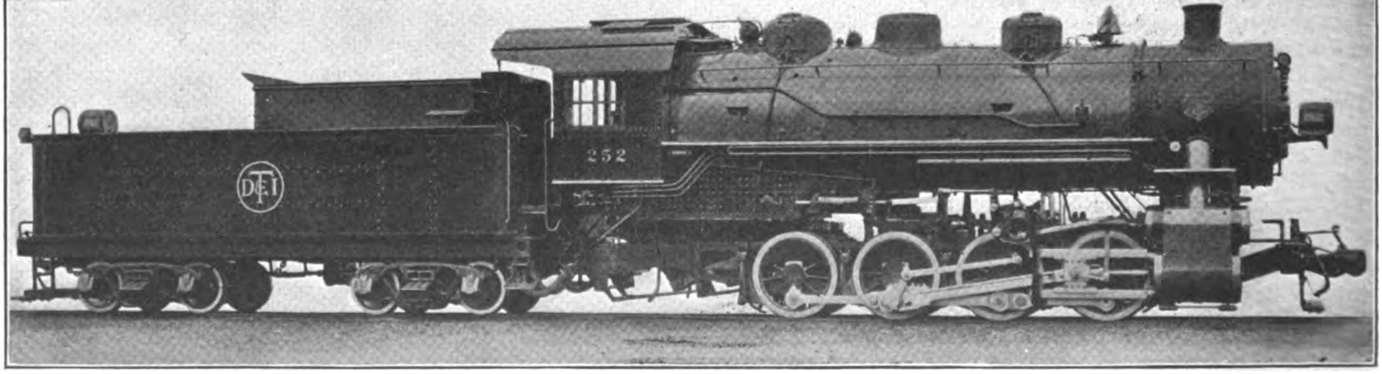
Six of this type recently delivered to Ford's railroad by the Lima Locomotive Works

The Detroit, Toledo & Ironton has recently received six 0-8-0 switching locomotives which were built by the Lima Locomotive Works. They have a total weight, in working order, of 219,000 lb. for the engine and 155,000 lb. for the tender. The tractive force is 51,200 lb.; factor of adhesion, 4.28; cylinders, 25 in. bore by 28 in. stroke, and the driving wheels are 51 in. in diameter. The height to the top of the stack is 15 ft. and the width over cab footboards, 10 ft. 2 in. The locomotives are designed for maximum grades of 2 per cent and for a maximum curvature of 19 deg.

The boiler is of the straight-top type, radially stayed,

Table of dimensions, weights and proportions

Builder	Lima Locomotive Works
Railroad	Detroit, Toledo & Ironton
Type of locomotive	0-8-0
Service	Switching
Track gage	4 ft. 8½ in.
Cylinders, diameter and stroke	25 in. by 28 in.
Valve gear, type	Baker-Pilliod
Valves	Piston type, size 14 in.
Maximum travel	6¾ in.
Outside lap	1 in.
Exhaust clearance	line and line
Lead in full gear	⅛ in.
Weights in working order:	
On drivers	219,000 lb.
Total engine	219,000 lb.
Tender	155,000 lb.
Wheel bases:	
Driving	15 ft. 0 in.
Total engine and tender	53 ft. ½ in.
Wheels, diameter outside tires:	
Driving	51 in.
Journals, diameter and length:	
Driving, main	10 in. by 12 in.
Driving, others	9 in. by 12 in.
Boiler:	
Type	Straight top
Steam pressure	175 lb.
Fuel, kind	Bituminous
Firebox, length and width	102⅛ in. by 66¼ in.
Tubes, number and diameter	230—2 in.
Flues, number and diameter	36—5½ in.
Length over tube sheets	15 ft.
Grate area	47 sq. ft.
Heating surfaces:	
Firebox and arch tubes	208 sq. ft.
Tubes and flues	2,569 sq. ft.
Total evaporative	2,777 sq. ft.
Superheating	610 sq. ft.
Comb. evaporative and superheating	3,387 sq. ft.
Tender:	
Style	U-shaped
Water capacity	8,200 gal.
Fuel capacity	11 tons
General data estimated:	
Rated tractive force, 85 per cent	51,200 lb.
Weight proportions:	
Weight on drivers ÷ tractive force	4.28
Total weight engine ÷ comb. heat. surface	64.6
Boiler proportions:	
Tractive force ÷ comb. heat. surface	15.1
Tractive force x dia. drivers ÷ comb. heat. surface	77.1
Firebox heat. surface ÷ grate area	4.4
Firebox heat. surface, per cent of evap. heat. surface	7.5
Superheat. surface, per cent of evap. heat. surface	22.0



Eight-wheel switcher built by the Lima Locomotive Works for the D. T. & I.

without combustion chamber, and with two circular courses 80 in. and 81-7/16 in. outside diameter. The working pressure is 175 lb. per sq. in. The boilers are equipped with Type A double loop, 36-element superheaters. There are 230 tubes, 2 in. in diameter and 36 superheater flues 5½ in. in diameter; the length over the tube sheets is 15 ft. The firebox is 66¼ in. wide and 102⅛ in. long with grates of the rocking bar type and a grate area of 47 sq. ft. The ash pans are of the center-hopper type. Hancock No. 11 Type A lifting injectors supply the feedwater. The total evaporative heating surface is 2,777 sq. ft. and the superheating surface, 610 sq. ft. Consolidated safety valves are used.

Steam distribution is effected by means of Baker-Pilliod valve gear, the diameter of the piston valves being 14 in. The valves are set with a travel of 6¾ in., 1-in. lap, ⅛-in. lead and line and line for the exhaust. A Lewis power reverse gear is applied. The air brake equipment was furnished by the New York Air Brake Company, and includes one 8½-in. cross-compound pump and two 18½-in. by 120-in. air reservoirs. The headlight equipment is Sunbeam with lights on both the front of the engine and the rear of the tender. The piston and valve rod packing is U. S. King type metallic. The Franklin unit drawbar and radial buffer are used between engine and tender. The material for axles and piston rods is alloy steel after Lima specifications, while that used for the side and main rods and crank pins is after specifications furnished by the Ford Motor Company. Brass shoes and mild steel wedges are used in connection with the usual type of cast steel driving boxes.

The tender is of the U-shaped level top tank type with a water capacity of 8,200 gal. and coal space for 11 tons. Bituminous coal is used. The tender tank is supported on a Comsco cast steel tender frame and four-wheel tender trucks which have cast steel truck side frames, elliptic springs and steel wheels. The important dimensions and proportions are given in the table.

Increasing income by reducing repair costs

By H. Y. Carpenter

Mechanical engineer, Davenport Locomotive Works, Davenport, Iowa.

A NUMBER of articles have appeared in recent issues of the *Railway Mechanical Engineer* in which comments have been made relative to the difficulties encountered in the making of certain locomotive repairs, due to faulty design. Many specific items were brought out, which, if corrected in the design of locomotives to be ordered in the future, would facilitate the work of maintenance and shorten the amount of time and labor required to do the work.

The biggest problem of the mechanical department is to keep its locomotives and cars on the road and to minimize the time they are held out of service for repairs. Men engaged in locomotive repair work can see practically every day many changes which could be made that would reduce the work of making certain repairs in both the back shop and enginehouse, and in some instances the repairs could undoubtedly be avoided altogether. The attention of the proper officers is often directed to certain difficulties encountered in the repair of a certain class of power, yet new locomotives are ordered having the same faults as those against which complaints have been made. Locomotives held out of service for any reason are actually draining the profits of those that are on the road and everything possible should be done to keep the equipment in service and out of the shop.

All too frequently such conditions are due to the manner in which the road purchases its locomotives. It reflects no discredit on the builders. Take, for example, a road that has never had any Mikado type locomotives and decides to place an order for a number of this type. Specifications are generally started about the time the operating department has begun to feel the pinch for additional power, and it is a matter of great importance that the earliest possible delivery be obtained. Specifications stating the size and type of engine, wheel loads, and various dimensions that appear to be about right for the conditions to be met, are sent to the builders together with a number of prints of a few parts which are fairly standard on the road. From this data, the builder must design and construct a locomotive and deliver the same in the shortest possible time. He adheres to the information given him and delivers a locomotive that is economical and satisfactory from an operating point of view, but when these engines begin to require extensive repairs, it is found that they do not fit in with the other power on the road, resulting in an increased stock for the stores department to carry. An increase in stock at one point is bad enough, but usually the locomotives are distributed over the system which makes it necessary for the stores department to carry increased stocks at many points to avoid delays by having to wait for deliveries from the general stores.

Co-operation with the builders is essential to standardization

In a case like this the builder's main concern is to build a locomotive to meet the specifications and blue prints furnished him and to meet the delivery date. With that he has his hands full. He has no time to investigate local conditions to see whether or not he can use rod brasses which would be common to some other type on the road and thereby keep down the number to be carried in stock. If he can use parts that are duplicates of what he has already made for some other road, it is to his advantage to do so, and so long as such a procedure does not conflict with the specifications and information furnished him, it is entirely legitimate to do so. But the point is that new parts are brought into existence which are not quite similar in design to others used on that road. The builder could have perhaps just as easily furnished parts that would have been common to one or more existing classes had he known what these were, but in cases of rush orders, he does not know nor does he have time to investigate. If only one part on a locomotive order for a single type was involved, the result would be negligible, but the chances are that it is many parts.

Take for example, a road that already has had one order of Mikado type locomotives and orders more from the same builder. Unless there is a great difference in the size of the locomotives on the two orders, a large number of the parts will be interchangeable. If a set of drawings accompanies the second order, the chances are that these drawings will be exact duplicates of those which the builder furnished with the first order. Unless these drawings have been revised to remove the objectionable features the second lot of locomotives will have as many objectionable features from the shop point of view as its predecessors.

Here is where closer co-operation between the shop and the office becomes noticeably desirable. If every man who had encountered any difficulty in the repair or operation of these locomotives submitted an account of his difficulties together with a proposed remedy, the mechanical engineering department could immediately incorporate

such suggestions into the design of the locomotives on the second order, if possible, and a decidedly better locomotive than those on the first order would result. To be sure, some criticisms do come in, but not all that should do so. A shop superintendent or a master mechanic may report some objection he has noticed, but the erecting gang foreman and the enginehouse foreman are seldom heard from. These men are the ones who find the small things, such as the side from which a pin should be put in, the application of which has required a disproportionate amount of time for repair.

The importance of following standard practice

There are unquestionably many parts that could be reduced from nearly as many varieties as there have been orders for locomotives to a few parts that would be standard to practically all classes. Among these are rod brasses, crank pins, driving and truck boxes, valve motion pins and bushings, crosshead pins, etc. For example, in the case of rod brasses, when a locomotive came into the shop which required new ones and those it had were not of standard design, more time than is usual would be required in applying it. But the next and each succeeding time the locomotive came in for repairs the time required to renew the brasses would be reduced to a minimum and there would be more of a possibility of the brass being in stock. It was found by one railroad that by redesigning its car trucks to be equipped with cast steel side frames, it could use one entirely new bolster and one new side frame on five different classes of 50-ton cars which had previously required as many different styles of side frames and bolsters.

Another fault to be found with many railroads has been the policy of purchasing a new type of locomotive before its adaptability to the operating conditions on the road has been fully determined. A case is known of one road which once purchased a number of Mallets only to find them unsuited to its operating conditions. The locomotives were sold to another road a few years later. The policy of the Pennsylvania of getting only one locomotive of a new type which is thoroughly tried out in service before an order for any quantity is placed, certainly has much to commend it. "It is better to have only one lemon than a bagful."

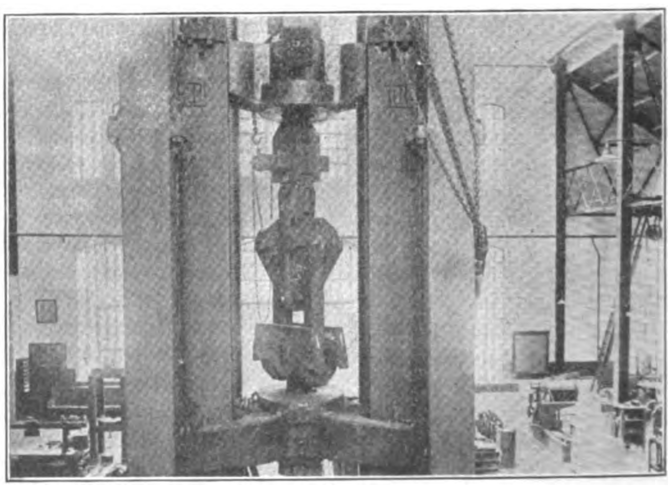
Locomotives should be designed by the mechanical engineering department

In the October number of Baldwin Locomotives, published by the Baldwin Locomotive Works, Philadelphia, Pa., is the third of a series of articles on the "Motive Power Development on the Pennsylvania System." The need of standardization was realized early in the history of the Pennsylvania and its locomotives have been developed one from another in a most logical and creditable manner. While the Pennsylvania has perhaps more locomotives of a single class than many roads possess altogether, what it has done can also be done to good advantage on many of the larger roads, even though they do not attempt to build any locomotives in their own shops.

The most feasible method of accomplishing the best results is for the mechanical engineering department of the railroad to design its own equipment, to fit the local conditions, which no builder can be expected to know sufficiently well to serve to the best advantage. By that, general design is not implied, but detail design; design that covers every part, so that when an order is placed a complete set of drawings accompany the specifications. The builder can then construct a locomotive which will fit in with the other equipment on the road. Sufficient inspectors should be provided to see that there is no deviation from the specifications, for even as small a matter as threads may cause considerable aggravation and delay in repairs. If such a course were adopted it should certainly lead to a considerable saving in maintenance. It would insure interchangeability of parts and would also result in getting locomotives which would come nearer to suiting local operating conditions.

This, however, cannot be done with the force usually allowed the mechanical engineer on many roads. As a rule, his department is only sufficient to handle the usual routine work. It should be large enough, however, to anticipate the needs of the future by preparing designs in advance. His office should receive reports of all engine failures, and be a clearing house for criticisms and suggestions relative to the road's equipment from the lowest man in the organization to the president. With a large amount of such data on file, with more arriving every day, each new design should be a distinct improvement over its predecessors. It is evident that the staff of the mechanical engineer should be adequate both in numbers and ability to carry the load that is thus imposed. While this department should be in close touch with the shop, it should not be relegated to unsuitable quarters, as the case on one large road, the mechanical engineering department of which is located just across the turntable pit from the enginehouse.

Many light repairs can be made without bringing locomotives into the enginehouse. This not only eliminates the delay incident to the two movements in and out of the house, but keeps it out of the way of other locomotives at busy times. It is such repairs as these that often necessitate putting a locomotive inside and making a short job a long one, on account of the parts being inaccessible or because the part furnished by the builders was not identical with that which the road carried in stock. Such cases can be cured by closer co-operation between the shop and the office, and by providing the mechanical engineer with complete failure reports together with unrestricted and uncensored criticisms, and by performing the complete detail design of future power in the road's own mechanical engineering department. This requires a broad minded policy on the part of the management as well as a sufficient and competent force under a mechanical engineer who is alive to the responsibilities imposed upon him. It will reduce the time required to make repairs, the amount of materials carried in stock and equipment will be in service more of the time.



Coupler yoke being tested for tensile strength at Lehigh University

Precipitation of water in compressed air systems*

By D. W. Lloyd

Assistant to general manager, Westinghouse Air Brake Company, New York

MANY technical articles have been prepared and are available for study, fully covering the laws governing the absorption and precipitation of moisture by air under pressure and temperature changes. Early investigators and scientists determined these laws many years ago. It is not the purpose, however, of this discussion to encroach at all upon this field of technical data but it is hoped that a strictly non-technical explanation concerning the working of these established laws may be of some assistance in obtaining a general understanding concerning them.

Atmospheric air always contains more or less moisture. Probably the most important function of the atmosphere is to convey and distribute moisture over the earth. Below the "dewpoint" or 100 per cent humidity mark, this moisture is in gaseous form, entirely invisible and as "dry" in the ordinarily accepted sense of the word as the air itself. When the saturation point or 100 per cent humidity mark is exceeded the excess water vapor condenses and becomes visible in the form of fog, which is made up of drops of water floating in the air. The atmospheric humidity varies continuously with changes in conditions, and the average humidity varies through wide ranges in different localities. The United States Weather Bureau shows the following mean percentages of humidities at different localities: Galveston, Tex., .85; New York City, .73; Salt Lake City, Utah, .53; Yuma, Ariz., .42; and El Paso, Tex., .39. It is somewhat curious that both the maximum and minimum values are found in Texas.

Effect of temperature and pressure on the moisture carrying capacity of air

The amount of moisture in a given amount of air at 100 per cent humidity depends on the pressure and the temperature. Considering pressure alone, the law states that the vapor carrying capacity varies inversely as the absolute pressure. In other words, if a cubic foot of free air, approximately 15 lb. absolute pressure at 100 per cent humidity is compressed to 60 lbs. gage pressure (75 lb. absolute) or five atmospheres, without change in temperature, it will be able to hold only one-fifth of the original moisture content in suspension and the remaining four-fifths will be precipitated as fog which will ultimately settle to the bottom of the container and form water.

To look at this from another angle, it is apparent that when the one cubic foot of free air is compressed to five atmospheres, its volume is reduced to one-fifth of the original volume. In other words, the space occupied is reduced in the same ratio as the ability to carry moisture in the form of vapor. This means that a given space can accommodate a given amount of water vapor regardless of the pressure of the air in that space, the temperatures remaining the same.

Changes in temperature, however, have a very pronounced effect on the amount of vapor that can be carried in suspension. The following table, which will be found in most hand books, gives the weight of water vapor per cubic foot of space at 100 per cent saturation and for each 1,000 cu. ft. of space at different temperatures:

Weight of water at different temperatures

Temperatures, degrees F.	Lbs. of water per cu. ft.	Lbs. of water per 1,000 cu. ft.
120	.00488	4.88
115	.00425	4.25
110	.00372	3.72
105	.00324	3.24
100	.00282	2.82
90	.00211	2.11
80	.00155	1.55
70	.00114	1.14
60	.000813	.813
50	.000585	.585
40	.000399	.399
30	.000271	.271
20	.000114	.114

This table may seem to be somewhat abstract for purposes of visualizing the actual amount of water that may be held in suspension in the atmosphere at 100 per cent humidity. A pint of water weighs 1.05 lb. so as a convenient point of comparison the reader will note that 1,000 cu. ft. of free air at 100 per cent humidity contains approximately this amount at normal room temperature of 70 deg. F.; in other words, the air in a room 10 ft. square with a 10-ft. ceiling can and does contain as much as a pint of water without causing any feeling of dampness whatever.

The tables will also show that within the normal range of temperatures, the amount of water vapor that can be held in suspension in this way is approximately doubled for each 20 deg. F. increase in temperature. This is only an approximate relation, but it affords a convenient means for easy analysis of the proposition within the limits of ordinary temperatures during compression and expansion.

Effect of increased temperatures

All are familiar with the fact that the temperature of air is increased during compression. We have then both the factors of temperature and pressure changes to consider when analyzing what happens to the moisture contained in the air drawn into the compressor suction, and as it passes from the compressor discharge out into the compressed air system. For example, assume an atmospheric temperature of 60 deg. F. and, for simplicity, a humidity of 100 per cent. This humidity is often obtained and is sometimes exceeded on wet days or where the compressor suction is exposed to drip or steam leaks. Assume also that the compressor is working against 75 lb. main reservoir pressure, which is approximately six atmospheres. The theoretical temperature due to compression is about 420 deg. F. This temperature will not actually be obtained, because of radiation from the cylinder walls. But as a conservative value, we can say that the air will be at least 200 deg. F. when it leaves the compressor discharge and enters the system.

The temerature between the inlet and discharge has therefore been raised at least 140 deg. F., or a total of seven steps of 20 deg. each. Considering that the moisture carrying capacity is doubled for each 20 deg. F. rise, its ability to carry moisture out of the compressor, as a result of the increased temperature, will be $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$, or 128 fold of what it was when it was

*Abstract of a paper read before the Manhattan Air Brake Club, New York, February 20, 1925.

drawn into the suction. Actually, the increased capacity due to this change in temperature is even greater than that obtained by this approximate method of calculation.

Effect of increased pressure

Offsetting this increased thirst of the air because of the heat, we have the effect of the increase in pressure. This effect is, however, only in proportion to the pressure increase which in this assumed case is six atmospheres, or six times the initial pressure. The net effect of the 128-fold increase and the six-fold decrease is the product of the two or more than a 20-fold increase. It will be apparent, therefore, that the air will not begin to deposit any of its moisture until considerable cooling has been effected. Under the assumed conditions, the precipitation will not start until somewhere along in the system where the temperature has dropped somewhat below 120 deg. F. Because at this point the temperature is still 60 deg. F. higher than the atmosphere, or three steps of 20 deg. F. each which produces $2 \times 2 \times 2$, or an eight-fold increase in moisture carrying capacity which still more than offsets the tendency of the increased pressure to reduce its capacity to one-sixth what it was in the beginning.

Five-sixths of the original moisture must be deposited somewhere between this point and the ultimate discharge from the system, assuming that the compressed air is finally cooled to the temperature of the atmosphere.

Collection of moisture in the brake system

The actual amounts of water that are involved in every-day air brake practice may be readily calculated. Even with a good tight train line the air lost from leakage alone in a 100-car train may run as high as 30 cu. ft. per min. If we assume that the average amount of air required for the train is 35 cu. ft. per min., or 2,100 cu. ft. per hour, under warm weather conditions with high humidity, we can see that about ½ gal. of water is being drawn into the compressor suction every hour and all but a small portion of it must be deposited in the main reservoir and elsewhere in the system. Fortunately, under cold weather conditions the atmosphere cannot carry as much moisture as in the summer, otherwise we would have much more trouble due to freezing of this condensation in the piping and the valve devices than is now experienced. The table shows that at freezing temperatures the amount of water is less than one-tenth of what it is at a temperature of 100 deg. F.

The radiating pipe on the locomotive is, of course, designed to provide as much cooling effect as possible on the locomotive so that the moisture may be deposited in the main reservoirs from which it can be drained. A recent survey of main reservoir piping on locomotives on various roads was recently made during which temperatures were taken at certain intervals of time during actual operation at various points in the piping to determine the efficiency of the cooling actually effected. In many cases it was found that the cooling pipe was located, either close to the firebox or in such a location that free circulation of atmospheric air around it was not afforded. This resulted in the air being reheated after leaving the first main reservoir, or possibly the second main reservoir and arriving at the brake valve, feed valve and other operating devices on the locomotive at a higher temperature than when in the reservoirs. This, of course, is a bad condition and increases the possibility of precipitation of moisture, with consequent damaging operating results in the valve devices on the locomotive and even in the train line.

It may be of interest to know the results of an investigation that was carried out by the Westinghouse Air Brake Company several years ago to determine to what extent water or condensation worked its way into the auxiliary reservoirs of freight brake equipment. During this investigation, which was carried out in the summer, more than 2,000 auxiliary reservoirs were examined. Water in varying amounts was found in 200 reservoirs or approximately 10 per cent of the total. The maximum amount in any reservoir was three gallons; another one had two gallons, and about 6 per cent out of the 10 per cent having any water at all had one pint or more. Practically all the dirt collectors on the cars examined either showed water or a rusty condition, indicating that they had held water at some recent time.

The length of radiating pipe

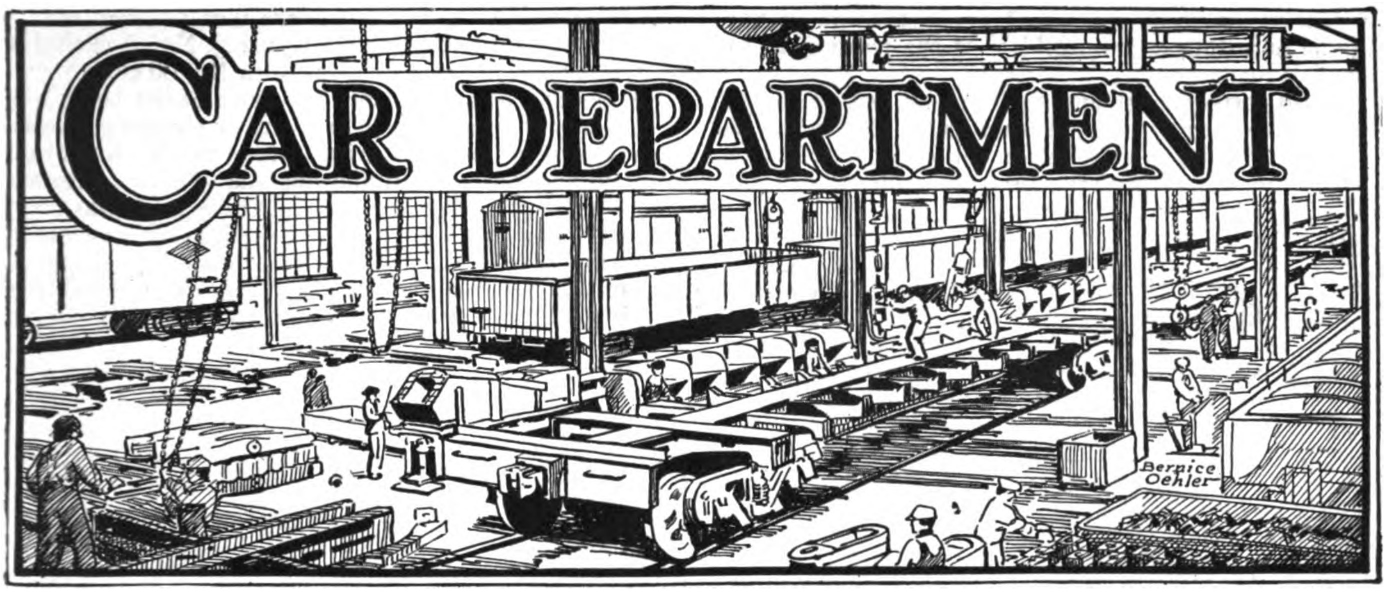
The Westinghouse Air Brake Company's recommendations as to length of radiating pipe for cooling purposes have for many years called for approximately 45 ft. between the compressor and the first main reservoir, and a like amount between the first and second main reservoirs. The Air Brake Association's recommended practice specifies as follows:

> Not less than 25 ft., nor more than 45 ft. of cooling pipe should be used between the air compressor and the first main reservoir. With two air compressors per locomotive, duplicate the amount of discharge pipe specified for one, these pipes to be connected to the main reservoir through a Y-fitting and a short two-inch extra strong nipple.
>
> The equalizing pipe between the main reservoirs should not be less than 1¼ in. in diameter and not less than 25 ft. nor more than 45 ft. long.
>
> The radiating pipe connected to the main reservoir should be located in the coolest possible place and placed so as to drain toward the reservoirs.

These recommendations allow considerable latitude. The reason for this is because it is practically out of the question to make any specific recommendation that will not be objectionable under certain circumstances. The atmospheric conditions in such localities as Florida and the Southwest differ widely from conditions in the Northern part of the country. The folly of attempting to specify an installation that will be equally well adapted to all conditions will be at once apparent. Under warm weather conditions, doubling or even tripling the lengths of pipe specified as a maximum by the Air Brake Association would not be sufficient to cool the air back to atmospheric temperature before reaching the brake valve. But under some extreme cold weather conditions, such an installation would without question permit the air to be cooled to freezing temperatures and below before even reaching the first main reservoir, with the result that the moisture would freeze and stop up the discharge to the main reservoir.

This condition has been obtained in steam road service and is quite a frequent occurrence in traction service. In order to avoid this and secure the desired results at all times would require an adjustable system which could be varied with changes in atmospheric temperatures, which is, of course, out of the question. The compromise to be sought is one that will produce a maximum of cooling with a minimum possibility of freezing.

It has been previously pointed out that the overall effect of compression of the air is to increase the thirst or moisture carrying ability of the air. Consequently, the effect of expansion is to cause a deposit of moisture. The effect produced as the air passes through the feed valve is well known to all air brake men. Drain cups, centrifugal dirt collectors with drain cocks, and reservoirs to catch condensation are commonly placed in the piping adjacent to the feed valve or under the brake valve and periodically drained of moisture collecting at this point.



The prevention of hot boxes*

A systematic record and analysis of the causes will suggest the proper remedy

By T. O. Quinn, Cleveland, Ohio

EPIDEMICS of hot boxes, no doubt, have been experienced by practically all roads handling any great volume of freight business, which has called for a large number of explanatory reports on the part of those in direct charge of car department work, these reports having been furnished generally, after a hurried investigation.

It is the writer's opinion that fully 75 per cent of the trouble caused by hot boxes is the direct result of the failure of the human factor to function properly, either through neglect or carelessness, and in some few cases through lack of proper methods and instructions. In order permanently to correct or eliminate such conditions, a thorough investigation from all angles is necessary before drawing any conclusions as to the principal cause for hot box epidemics, taking into consideration the human element involved and the possibility of the working force neglecting or overlooking some minor detail of the work assigned them. By the time the cause is located the organization is generally working to the entire satisfaction of all concerned, and can only be maintained at that point by the proper supervision of those engaged in hot box prevention work.

My experience leads me to believe that epidemics of hot boxes are caused mainly through improper lubrication and that in about three-fourths of the cases improper lubrication is due to the failure of the human element, and is not generally due to mechanical conditions. To lubricate properly the journals of railway freight equipment, considerable training of forces doing this class of work is required, as the "car knocker" is the principle cog in the machinery that causes, and through whom the cures are effected, where the hot box epidemics are concerned. Therefore the importance of his duty must be shown him in such a manner as to secure his interest in the work he is to do, if corrective measures are to be applied and satisfactory conditions maintained.

Methods to be followed to get the proper lubrications with our present lubricating system should consist of the packing and adjusting of journal box packing in the following manner, providing that the journal packing has been properly saturated with a good grade of car oil: first, in packing or repacking of a journal box complete, there should be inserted in the mouth or front of the journal box, a roll of journal packing, approximately 2½ in. in diameter and 10½ in. in length for journals 8 in. and 9 in. in length, and a roll approximately 3 in. in diameter and 12 in. in length for journals 10 in. and 11 in. in length, the rolls to have the ends square and uniform and to be held in a firm position by being tied with strands of waste or their wrappings, and then worked back under the journal to the extreme back of the box, leaving it in such a position that it does not extend above the center line of the journal. The rest of the packing is then placed firmly under the journal to prevent settling away from it, this being accomplished by placing the packing across the full width of the mouth of journal box, allowing the strands to hang down outside until packing is complete. Additional packing is applied on top of the overhanging strands, which form a binding for the entire mass and prevents the separation of the packing. The journal packing, when completed, should not extend above the center line of the journal at any point, neither should the front of the box be filled with packing, as this prevents proper inspection and does not lubricate the journal.

The attention to journal packing where repacking of

*A paper submitted in the competition on hot box prevention which closed March 1, 1924.

the box is not required, should consist of inspection, and the adjusting and reworking of the packing in the following manner:

Careful inspection should be made by close examination of the journal and contained parts of the journal box and defective mechanical conditions corrected. On a box where no mechanical defects exist and the journal shows any indication of heating, the journal packing should be loosened and pulled forward from the sides and worked back under the journal from the center, in order to break up the glazed surface of the packing from long contact with the journal and to raise the center portion of the packing in the box against the bottom of the journal. Where excessive packing or packing in a dry condition is encountered, it should be removed and in case insufficient packing remains, fresh saturated packing should be inserted and worked under the journal from the front and bottom portion of the box, raising the packing on each side to the center line of the journal.

Hot box epidemics, where they have been due to the lack of proper attention, have been corrected and satisfactory conditions maintained by following closely the above methods.

Sometimes it is difficult to determine the particular employee at fault or the one that is negligent in performing his work and some system is necessary whereby that person can be located and properly instructed. The method outlined below has been worked out and followed with success in a number of cases where hot box epidemics were caused through the failure of one or more men in the organization.

At the larger terminals where a large force of oilers is used, the men are divided into crews or gangs of four. One oiler takes care of the outside boxes on one side of each car in the train, and one oiler takes care of the inside boxes on the same side, the other two oilers handling the opposite side in the same manner, two men working always on the south or east side and the other two men always working on the north or west side. When oiling attention is completed the last man finishing a car on his side applies identification marks with chalk showing the station, symbol and date.

Hot box forms such as illustrated, are made out either by the inspector or the trainman whenever cars are set out or require attention en route. This form when filled out complete, contains all the information required to locate the oiler last giving the box attention at a terminal, prior to the departure of the train. The completed forms are made in duplicate and one copy forwarded to the car foreman at the originating point and one copy to the division car foreman or district master car builder, which enables the supervisors to deal at once with the party responsible, where the cause would indicate that failure was due to lack of attention.

Improper turning or truing of journals, resulting in hot boxes within a short time after application or change of wheels is one of the lesser causes of hot boxes. This arises in a number of cases from the use of a roller for applying the finish to journals. Where a roller has been used it has been found that the fine edges left from cutting or finishing tools are merely rolled into the journal only to be brought out when more than ordinary friction heat is produced, the result is a cut journal before the journal bearings become properly seated. The exact fitting of journal bearings is of minor importance where all other conditions are normal.

Where this condition was found the use of the roller was done away with entirely and journals for both freight and passenger service turned in the usual manner, a finishing cut being taken about 3/64-in. in width, particular attention being paid to see that collars and fillets are turned properly. The journals are then polished with a polishing stick and emery cloth, using No. 2 cloth for the first application and finishing with No. 00 cloth.

On another occasion a small epidemic of hot boxes was caused by car repairmen, in applying or changing wheels, preparing their journal bearings with a thin coating of oil prior to application, then allowing the bearing to remain near the ground while the balance of the work was completed on the car. In some cases the bearing was left in this position for an hour or more, with the natural result that the oil caught and retained all the foreign substances striking it. At the time the epidemic developed the season

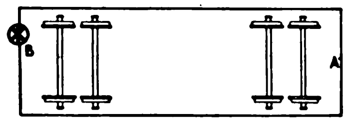
ABC RAILROAD

INSPECTORS AND TRAIN CONDUCTOR'S HOT BOX REPORT

Report only boxes that are smoking hot and require packing or change of brass by reason of running hot

Date______ Train No.______
Division______ Station______
Car Initials______ No.______ Kind______

If freight car, show on diagram location of hot box
If passenger car give box number
Show side, North-South-East-West
Show station and date last given oiling attention



Date Boxes Last Repacked

Probable cause of heating indicated by drawing line through cause which applies to the case. If none give cause in remarks	1. Lack or Waste	6. Doubtful
	2. Brass Worn Thin	7. Waste Grab
	3. Overloaded	8. Wrong Brass
	4. Brass Worn Unevenly	9. Broken Brass
	5. Journal Rough or Seamy	10. Lining Cracked

Delay to train______ Hours______ Minutes
Originating point of shipment______
Cap'y of car______ Weight of load______

Remarks:______

Inspector or Conductor

This report must be made out promptly and sent to Division Master Car Builder for all hot boxes. Division Master Car Builder to forward one copy to Foreman at originating point.

Sample of the form used for reporting hot boxes

was extremely windy. When located, the matter was readily corrected by the exercise of more care in the handling of the journal bearings.

An increase in hot boxes generally follows a serious reduction in car department forces or when labor troubles are encountered, such as were experienced during 1922, but the result can hardly be called an epidemic. This condition is more generally due to a lack of attention and involves both the human and mechanical conditions.

The mechanical features resulting in the occasional hot box are generally understood and involve such defects as:

1.—Worn journal bearing, resulting in cracked bearings and improper bearing surface.

2.—Bent arch bars and truck out of line, resulting in the weight of the load being equally distributed on the journal bearing.

3.—Slid flat or shelled out wheels, causing the journal packing to settle away from the journal through the jar of the wheel, resulting in lack of lubrication and also distorting the contour of the brass.

4.—Improperly fitting journal wedge, resulting in uneven wear on the bearing.

5.—Missing journal box covers, permitting foreign substances of all kinds to enter the box and prevent proper lubrication of the journal.

By closely following the methods outlined hot box epidemics have been entirely eliminated and car failures per mile from this cause reduced to a minimum, resulting in increasing the mileage on the division where this method has been carried out to 585,113 miles per failure.

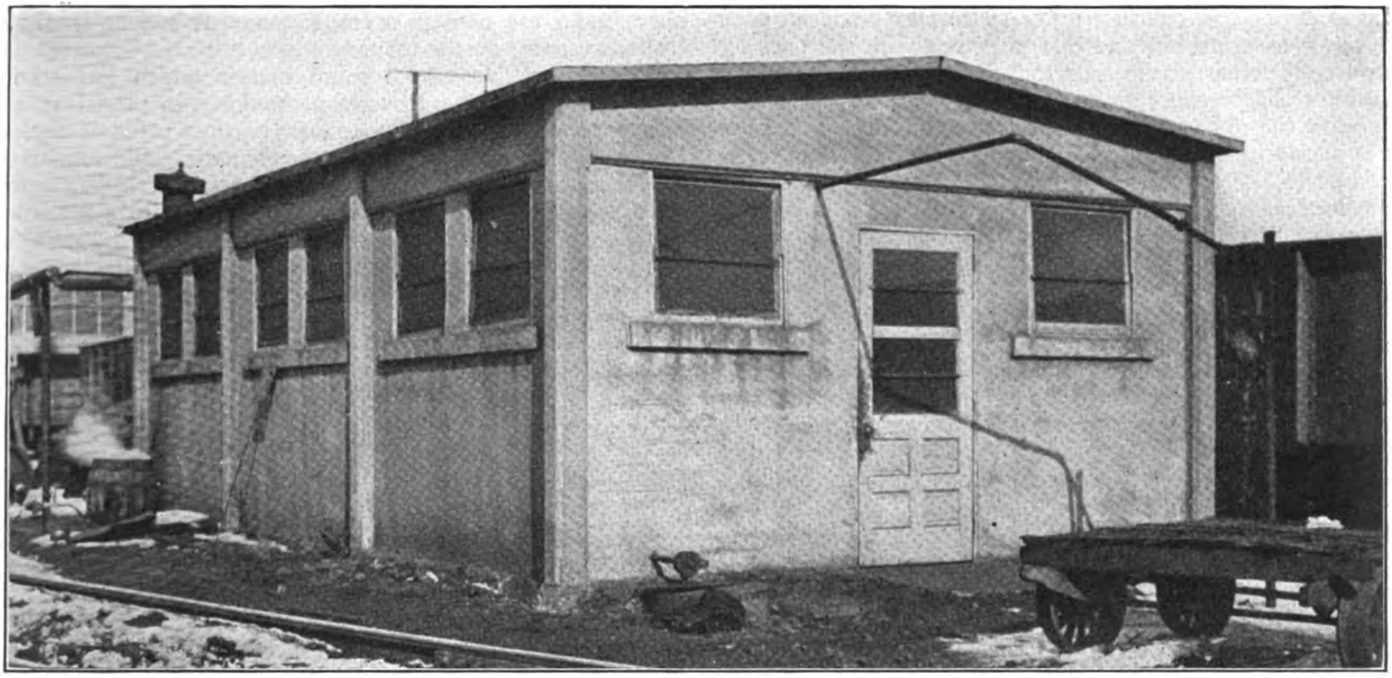


Fig. 1—Exterior view of the oil and waste reclamation plant. A corner of the storage bin for receiving packing to be reclaimed can be seen extending beyond the building at the extreme left.

Reclamation of car journal packing

A description of the system used on B. & L. E. for the conservation of oil and waste

By G. Charles Hoey

Draftsman, mechanical department, Bessemer & Lake Erie, Greenville, Pa.

ONE of the most important jobs that the car department must do to obtain satisfactory car mileage is to provide for the proper lubrication of car journals. It is essential that the proper grade of oil and waste be supplied and the work of packing the

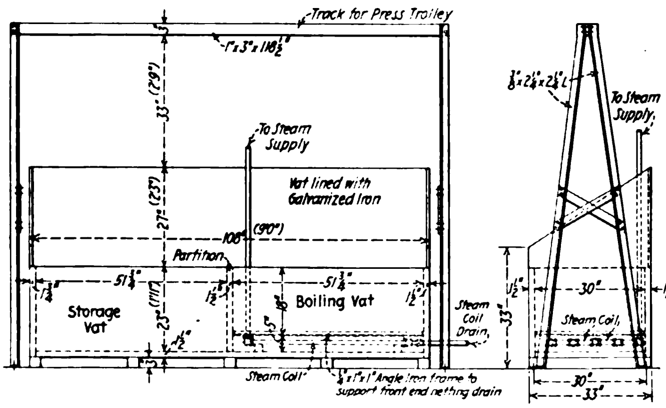


Fig. 2—Vat for boiling and storing reclaimed journal box packing

journal boxes be properly performed. It is has been noted that this particular phase of car repair work was emphasized in the papers submitted in the competition on the prevention of hot boxes which have been published during the past year in the *Railway Mechanical Engineer*. The reclamation of oil and waste is a question of prime importance in the work of car maintenance and in order to make it a real economy, it is essential that proper methods be used.

The oil and waste reclamation plant of the Bessemer & Lake Erie is located at its principal car repair shops, Greenville, Pa. All heavy repairs to steel and wooden freight cars and passenger equipment are performed at these shops. At the present time, the entire product of the oil and waste reclamation plant is used at the Greenville car shops which turns out an average of 25 cars a day.

The work of packing the journal boxes is left until the cars have gone through the repair shop and are spotted on the outbound track for stencilling, and testing of the air brakes. The journal box packing gang, consisting of three men, removes all of the packing from the journal boxes and transports it in low-side steel wheel-barrows to a steel storage bin located just outside the building, as shown in Fig. 1. A load of reclaimed waste is taken on the return trip and the boxes are repacked.

Reclaiming old waste and babbitt

Only one man is employed in the actual work of reclamation. Referring to the drawing of the floor plan, packing is removed from the storage tank to the picking table, which is placed in a convenient position for the attendant to work from the storage tank and thence to the two tanks for boiling and storing the reclaimed "dope." The top of the picking table consists of a screen made of front end netting on which the waste from the old pack-

ing is cleaned and fluffed up. All foreign material such as pin grease, babbitt and dirt, together with the packing unfit for further service is removed by picking or it falls through the screen into a bin underneath.

After the old packing has been cleaned and fluffed up, it is placed in the boiling vat, shown in Fig. 2. This vat is located in the corner of the building at the right of the entrance leading in from the storage tank. It is lined with galvanized iron and is separated from the storage vat by a 1½-in. partition. The packing is supported on a screen made of front end netting placed five inches above the bottom of the vat. Sufficient oil is placed in the vat to cover the "dope." Heat for boiling the oil is supplied by a steam-coil underneath the screen. Under ordinary conditions, a batch of reclaimed "dope," consisting of approximately three wheel-barrow loads, is allowed to remain in the boiling vat for about one hour. However, at times when the car shops are working under unusual business conditions, the "dope" is not allowed to boil more than

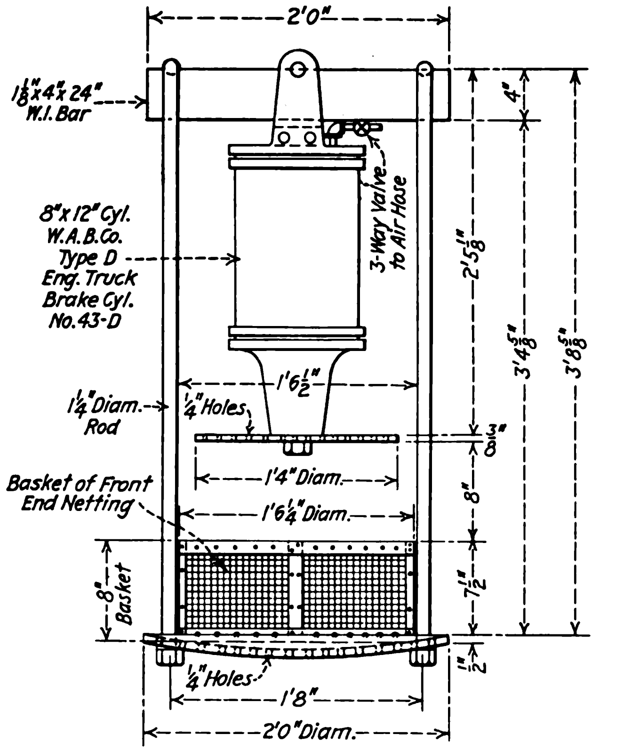
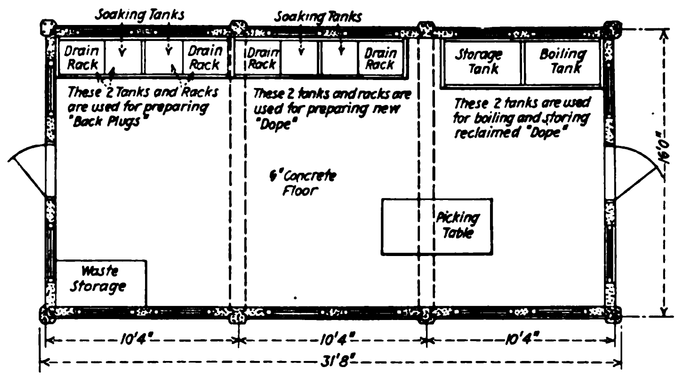


Fig. 3—Press for extracting the oil from the "dope" at the boiling vat

30 min. After the "dope" is boiled, it is pressed in the press shown in Fig. 3 and placed in the storage vat until removed by the journal box packing gang.

The press is carried over the boiling and storage vats on a monorail made of 1-in. by 3-in. flat iron supported on two ⅜-in. by 2¼-in. by 2¼-in. angles placed at the ends of the vats, as shown in Fig. 2. It consists essentially of a basket constructed of front end netting, 18¼ in. in diameter and 8 in. deep. The bottom of the basket is made of a ⅜-in. steel plate, dished as shown in Fig. 3, and is provided with a large number of ¼-in. holes to permit the oil to escape. The work of pressing is done by means of an 8-in. by 12-in. Westinghouse, type *D* engine truck brake cylinder. A ⅜-in. steel plate, 16-in. in diameter is secured to the end of the piston rod which has been turned down to a smaller diameter and threaded for a nut which holds the plate in position. Compressed air can be admitted to the cylinder from the shop air line by means of the three-way valve located at the top. The basket and air-cylinder are held in a frame which is swung from a trolley running on the monorail.

All of the dirt and foreign matter which has been removed during the process of picking is placed in a furnace and burned. The furnace is constructed of sheet iron with a screen made of front end netting, for supporting the material. Underneath the screen is a piece of sheet iron which slopes to the front of the furnace. As

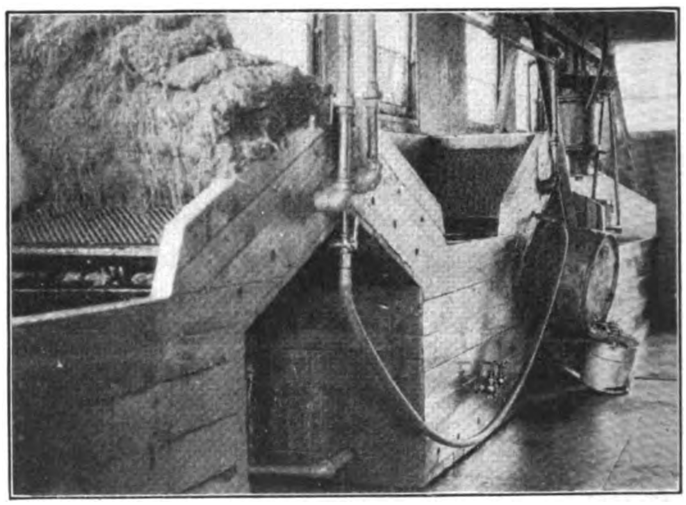


Floor plan of the plant for reclaiming oil and waste for journal box packing

the material burns, the babbitt metal drops through the screen and rolls down the sloping sheet.

Reclaiming the oil

In order to make the reclamation of oil a real economy, it is essential that it be done right. Many hot boxes are caused by foreign substances in reclaimed oil, which collect along the edge of the bearing until the accumulation is sufficient to wipe the oil off the journal. This material also works its way into the bearing, forming a carbon



An interior view of the packing reclamation plant showing the arrangement of the tanks and racks for preparing new "dope" and "back plugs"—The press and boiling vat is shown in the background

coating absolutely void of any anti-friction quality, which results in the gradual heating of the car journal. However, very little trouble of this nature has occurred on the road, due because of the process of filtration used in reclaiming the oil.

As excess oil accumulates in the boiling vat, it is removed and run through a filter. All foreign matter is removed by a process of slow heating, filtration and settling. The filtering apparatus consists of three steel barrels. The first barrel is equipped with a filter or

strainer and has a steam coil at the bottom. A pipe leading from near the top of the first barrel, carries the oil by gravity to the bottom of the second barrel. A similar piping arrangement connects the second barrel to the third barrel which is equipped with a steam coil, like the first, and a cock for removing the oil.

Oil from the boiling vat, which has accumulated from the boiling and pressing process is allowed to thicken and is poured through the filter into the first barrel where it is heated and agitated. As the barrel becomes full of oil, it escapes through the pipe to the second barrel, which serves as a settling tank. As the second barrel becomes full it flows in the same manner as from the first to the

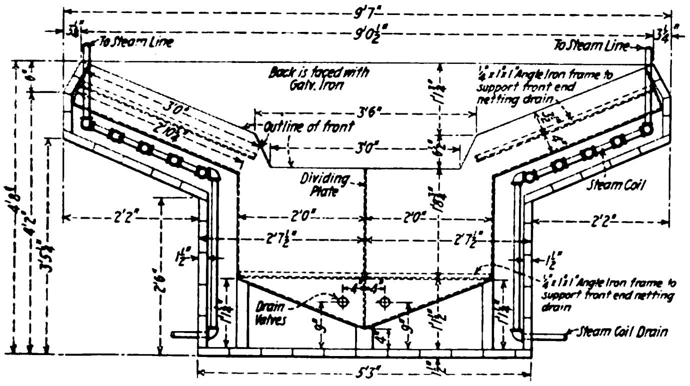


Fig. 4—Vat for soaking and draining new packing

third barrel where it is heated sufficiently to be drawn off and placed in storage.

Ordinary steel tubs are used for the handling of dope in the reclamation plant. All new "dope" and back plugs are soaked for not less than 16 hours in the double compartment vats shown in Fig. 4 and are then placed on the sloping drains as shown in the interior view of the plant, until it is needed by the journal box packing gang.

Practically the entire time of two men of this gang is devoted to repacking journal boxes. The time of the third man is used for packing journal boxes having new wheels.

This plant, which employs one man, supplemented by a gang of three men, maintains an average daily output sufficient for 25 cars. However, providing it is not necessary to use a large amount of new packing, which requires a longer time to soak, an output of 50 cars a day can be readily handled. Old packing is sometimes shipped in from outlying points to be reclaimed, but no special effort is made to collect all the old packing at such points. When a surplus does occur at any outlying point, it is shipped to the plant for reclamation. Old packing from locomotive journals and tender truck journals at the Greenville locomotive repair shops is also reclaimed at this plant and used for car journals.

The car department has entire supervision over this plant. "Dope" is taken from the storage bin as needed, no order or requisition form being used. The plant consumes approximately 12 barrels, containing 52 gal. each, of oil and three bales of waste, weighing 330 lb. each, in 15 working days. It is estimated that each car requires an average of 21 lb. of waste and 9½ gal. of oil.

The London & North Eastern Railway has announced that all passenger train rolling stock which it acquires henceforth will be built on the articulated principle. The company has recently received the first of 29 articulated trains which it has under order, each to consist of two five-coach articulated units. Savings in weight, increase in the comfort of travel and reductions in train length are the principal advantages afforded by articulation.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Switching damage through hand brake failure

Barrett Company, tank car No. 4210, was damaged in switching service on the Chicago, Milwaukee & St. Paul lines. The handling line repaired the car and rendered a bill to the car owner. The handling line contended that the damage to the car occurred in fair usage while the car owner took the position that such extensive damage could not have occurred in ordinary handling, but must have been the result of undue impact occasioned through other than regular switching and that, under section *D*, Rule 32, the handling line was responsible and should issue authority for an offset bill. The Barrett Company in submitting its side of the case to the Arbitration Committee, stated that the tank shifted 5 ft. 6 in. to the B—end, breaking all anchor bolts and tank anchor bands. They claim that this was the result of unfair usage as the car was built in July, 1916, and equipped with center anchorage. The handling line stated that when the rider in charge of the car commenced to tighten the hand-brake, the clevis, which was on the end of the rod and connected with the floating lever, broke under the strain, making it impossible to set the hand brake. Upon inspection, it was found that the break in the clevice was new.

The Arbitration Committee rendered the following decision: "The evidence shows that the handling line provided rider protection and that every reasonable effort was made to protect the car. Therefore, the car owner is responsible."—*Case No.* 1923, *The Barrett Company vs. Chicago, Milwaukee & St. Paul.*

Depreciation on a destroyed car

On May 15, 1923, Chesapeake & Ohio box car No. 5399 was badly damaged in an accident on the St. Louis-San Francisco. The depreciation statement furnished by the owners shows that the car was built in July, 1914. The repairing line took exception to this date, as the underframe of the car was stencilled "rebuilt June 1910." A representative of the repairing line was sent to the office of the superintendent of the car department of the car owner and was informed that the original C. & O. car No. 5399 was built April 16, 1889, destroyed January 29, 1890, rebuilt June 29, 1899, and sold to a foreign company December, 1915. He was further advised that C. & O. car No. 85399 was built July 10, 1914; after the original car No. 5399 had been sold, car No. 85399 was changed to No. 5399 and that this was the car in question. The St. Louis-San Francisco contended that the depreciation should be figured from April, 1889.

The C. & O. stated that the car in question was built by the Central Locomotive and Car Works, July 10, 1914, and outshopped as car No. 85399, which number was changed to read No. 5399 on the owner's line August 8, 1916. The original car No. 5399 was built April 16, 1899, and was destroyed on the owner's line January 29, 1890, and rebuilt June 29, 1891, and then sold September, 1915. The car owner further stated that none of the

order of cars in which the car in question was included was delivered earlier than 1914. Therefore, the stencilling on the steel underframe showing the car rebuilt in 1910 was in error. The car owner concluded by stating that the settlement made for a car destroyed on a foreign line should be based on the original date built, according to Section D, Rule 112.

St. St. Louis-San Francisco claim that the fact that the underframe of the Chesapeake & Ohio car No. 5399 was stencilled rebuilt June, 1910, was positive evidence that the car was not entirely new when released by the builder July, 1914. Therefore, the depreciation should be figured from 1889.

The Arbitration Committee rendered the following decision: "Additional evidence submitted by the Chesapeake & Ohio substantiates their claim that the car body in question was built new in July, 1914. Therefore, the depreciation should be figured from that date."—*Case No. 1320, Chesapeake & Ohio vs. St. Louis-San Francisco.*

Exceptions taken to the cost of repairs for items listed on defect cards

On November 22, 1922, and June 27, 1923, the Kansas, Oklahoma & Gulf issued defect cards covering defects on T. A. R. X. car No. 2. On March 27, 1923, the Allied Refining Company rendered a bill for $358.51 for repairing the defects. The handling line objected to the bill on account of the repair card not being rendered in accordance with the A. R. A., Rule 7, Section 2, contending that it entitled it to a statement showing the actual material billed for. Exception was taken also to the charge of $58.00 for repairs to the tank head which it refused to pay according to paragraph 2 of Rule 4. The K., O. & G. also took exception to the charges made for replacing the dismantled underframe with another one, because Rule 94 does not cover this item. The Allied Refining Company stated that the defect card was issued several months subsequent to the date on which the damage actually occurred. The repairs were based on prices as covered by the particular code of rules in effect at the time of the accident. The car underframe was scrapped and charges were made against the defect card, according to Rule 94, for material only.

The Arbitration Committee rendered the following decision: "Defect card for delivering line defects should be dated not later than the first interchange of the car. Labor and material prices must conform to the rules in effect at the date of the defect card. With reference to the dismantled underframe, which was replaced with another one, the charge for labor and material should not exceed what would have been required for repairs or necessary renewals of the damaged parts in kind. With reference to the tank head, concerning the cost of repairs of which the car owner is not in possession of definite information, the Committee feels that the charge of $58.00 billed is not excessive."—*Case No. 1327, Kansas, Oklahoma & Gulf vs. Allied Refining Company.*

Another Rule 32 case

On May 17, the Philadelphia & Reading reported that N. O. T. & M. box car, No. 730, was damaged on its lines and requested the Gulf Coast lines to furnish a statement showing the depreciated value of the car. The matter was further investigated and it was found that the car came under the provisions of Rule 120 and accordingly, on May 29, an inspection certificate was furnished.

The Philadelphia & Reading stated that car No. 730, built during 1907, was the tenth car in a draft of 18 cars standing on the south end of a siding. Thirty-two cars were standing on the north end of the siding with a space of about eight car lengths between the two drafts. An engine crew backed eight cars against the draft of 18 cars and started to back a draft of 26 cars against the draft of 32 cars, and when the two drafts came together, car No. 730, the 18th car from the engine, buckled. No derailment resulted and no other cars were damaged in any manner whatever. The handling line further stated that the damage was the result of the weakened condition of the car, as the center sills, having no cover plates and being weakened by corrosion as the result of nearly 15 years service, naturally failed to stand the regular shock of switching.

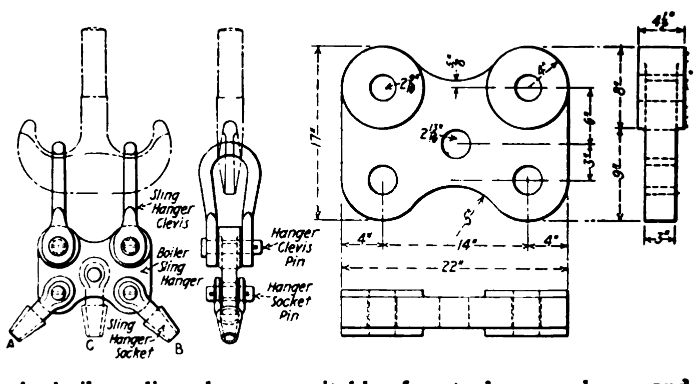
The car owner in making its contention, claimed that upon investigation by its representative, it was found that the damage to the car was due to handling and the failure of the flagman to get his signals to the engineman in order to avoid striking the second cut of cars. The car owner further pointed out that the assistant train master of the handling line recommended suspension and discipline for the members of the crew in their failure to perform their duties properly which resulted in damaging the car, thus inadvertently admitting its responsibility.

The Arbitration Committee in making their decision stated that: "According to the statements submitted by the train crew, signals were given with the intention of having the engineman stop, but the signals were not given in such manner as to be observed by the engineman. Therefore, under Section (d), Item 2, Rule 32, handling line is responsible."—*Case No. 1322, Philadelphia & Reading vs. Gulf Coast.*

Boiler sling hanger for wrecking service

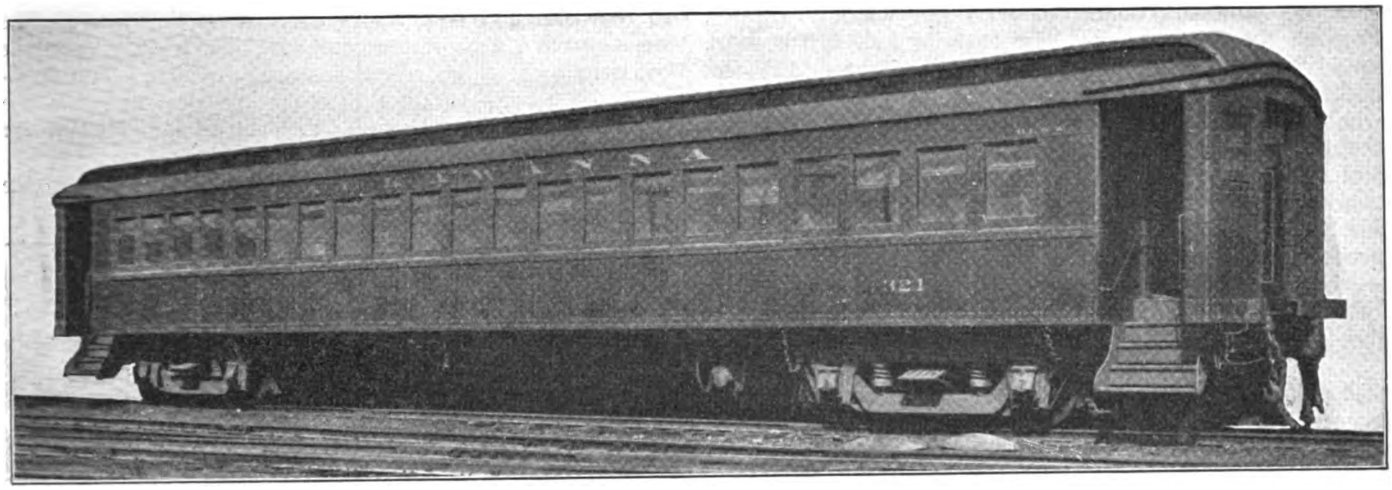
THE boiler sling hanger, shown in the drawing, was designed primarily to be included in the equipment for wreck cranes. It can, however, be used to advantage as part of the crane equipment in tank car shops and in locomotive erecting and boiler shops.

The hanger is forged from a solid piece of wrought



A boiler sling hanger suitable for tank car shops and locomotive erecting and boiler shops

steel and machined to the dimensions shown in the drawing. Referring to the side and end views of the assembly drawing, the calculated working load with the sling attached at *A* and *B* is 150,000 lb. The calculated working load, with a line attached at *C* only, is 125,000 lb. The three slings together are capable of handling any weight of locomotive, boiler or tank.

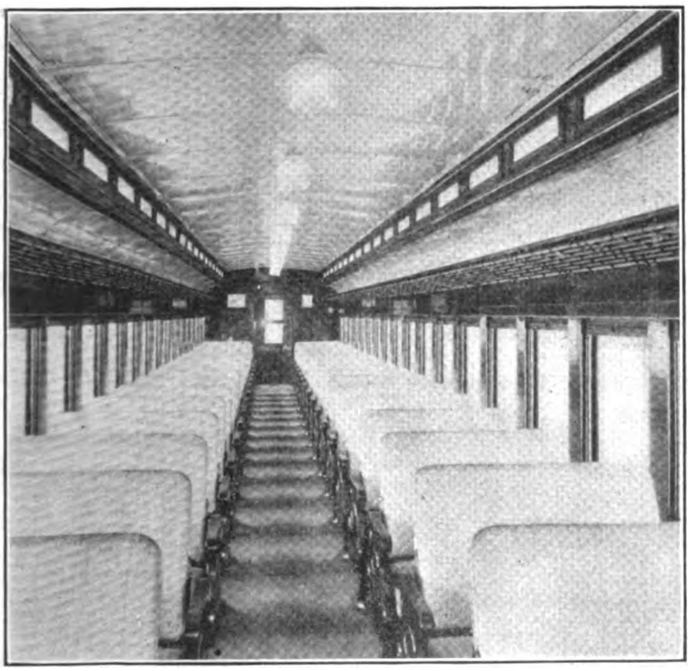


D. L. & W. Suburban Coach

Suburban cars for the D. L. & W.

All-steel construction with seating capacity of 82 passengers —Total light weight 106,000 lb.

THE Delaware, Lackawanna & Western has recently placed 50 new steel suburban coaches and 10 suburban combination passenger and baggage cars in service between Hoboken and outlying points in the New Jersey suburban district. The 50 coaches were built by the Pullman Car & Manufacturing Corporation and the 10 combination cars were built by the Bethlehem Shipbuilding Corporation, Ltd.



The coaches have seating accommodations for 82 pasengers

Several important details in the design of the cars are so carried out that they may be easily transferred to and arranged for operation in multiple unit service should the Lackawanna, at some future date, decide to electrify its suburban territory.

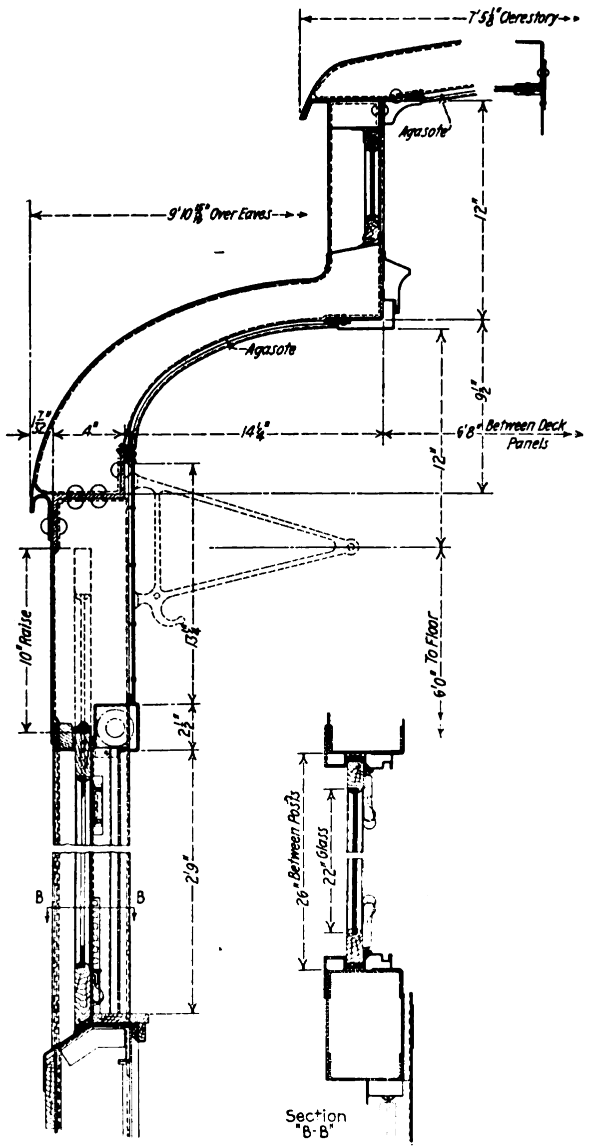
The cars are of steel construction throughout with steel interior finish. The underframe and superstructure details have been so designed as to provide the maximum possible strength consistent with weight limitations. The framing has been designed with a view to providing a car as nearly anti-telescoping as possible. The underframe consists of center sills of the box girder type made up of two 10-in., 23.6-lb. ship channels with 5/16-in. top and bottom cover plates. The center sills extend in one length between the buffer end sills. The side sills are 6-in. by 4-in. by ½-in. angles. The body bolsters are built up of ¼-in. pressed steel pans with bottom cover plates 7/16 in. thick and top cover plates of 5/16-in. steel. The cross bearers are pressed steel pans of ¼-in. plate and extend from side sill to side sill. Floor pans, pressed from ⅛-in. steel plate, extending from center sills to side sills serve as floor supports and provide additional transverse reinforcement to the frame. The bottom floor plates are supported on 5-in. by 3/16-in. floor stringers riveted to the cross members the full length of the body underframe. In addition to the buffing shocks, the underframe is designed to carry the weight of any electrical apparatus which may later be suspended beneath the car.

Details of body construction

The side posts consist of two 4-in. by ⅛-in. pressed steel channel sections placed flange to flange and the corner posts are built up of a 4-in. by 3-in. by 5/16-in. angle and a 4-in., 8.2-lb. Z-bar. The roof framing consists of pressed steel carlines, ⅛ in. thick. The carlines for the lower deck are continuous from the top of the side posts to the under side of the upper deck carlines to which they are riveted and, in fact, form the side posts for the side walls of the clerestory. The carlines are supported by a 4-in. 8.2-lb. Z-bar plate riveted to the side posts.

The side walls are of steel inside and out, except for an interior lining of ⅜-in. Agasote below the window sills to a point 10 in. above the floor. The exterior side sheets have vertical splice plates running from the bottom of the car side to the letter board between the window

openings and, in connection with the window frames, forming the post covers. The exterior belt rail is 4 in. by ½ in. and the letter board is of ⅛-in. steel 12½ in. high, with inside splices and welded joints. The single window frames with welded joints, in addition to forming the sash guides, also act as belt rail caps, side post covers and letter board stiffeners. There are 21 single sash windows on each side of the car. Wood sashes of ⅞-in. Mexican mahogany are fitted in such a manner as to provide unobstructed vision when raised. The window sills are of the same material as the sashes. O. M. Edwards window fixtures are used. The headlining on the lower deck is 3/16-in. Agasote and ¼-in. Agasote

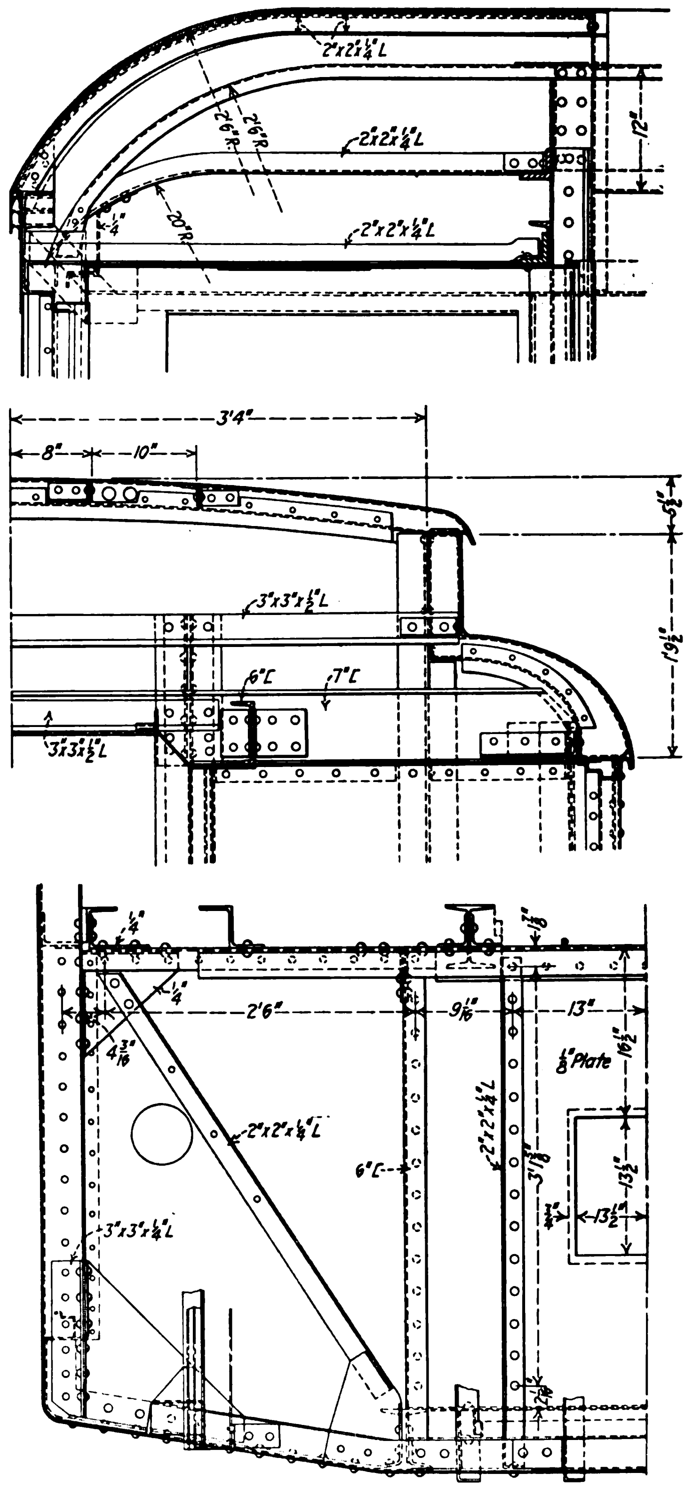


Sectional view of the side walls and roof

is used on the upper deck, all joints being covered with steel battens. The outside roof sheets are No. 14 gage on the upper deck and No. 16 gage on the lower. Swinging window sashes in the upper deck provide ventilation.

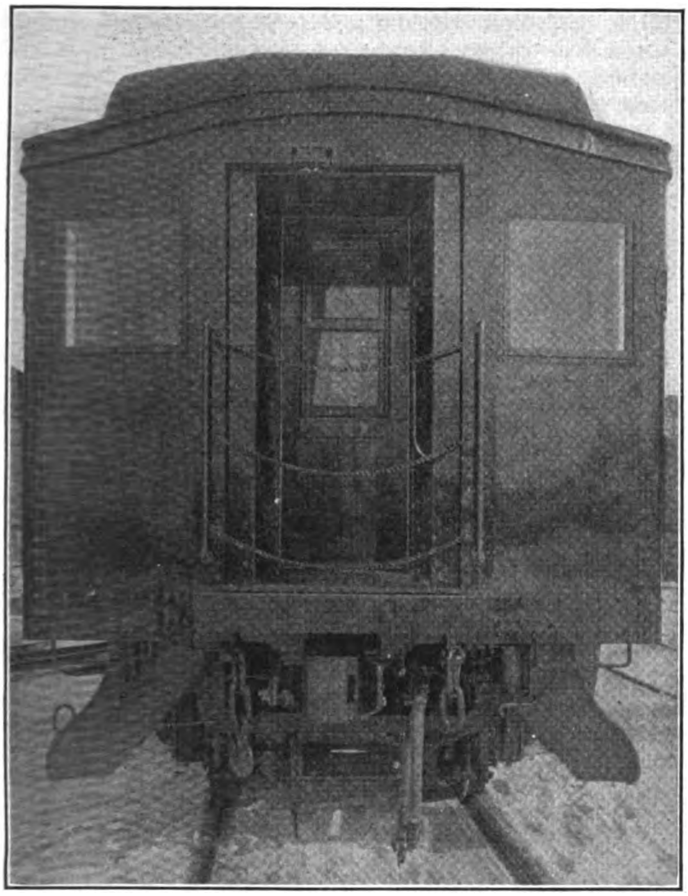
The platforms are of built-up steel construction, with cast steel buffer beams, pressed steel buffer wings and ¼-in. platform plate. The floor plate is riveted to the buffer beam, platform arms, center and body ends sills. Box type vestibule frames are provided with each end door post and the corresponding vestibule posts made of 6-in., 23.9-lb. H-beams. The floor and steps are covered with Feralun safety treads and the vestibules are arranged so that end and trap doors may be applied later. The steps provide a passageway 2 ft. 11 in. wide. Vestibule end windows with steel sashes are provided. The vestibule space and window location are designed for the possible future installation of electric control and air brake equipment.

The flooring consists of an under floor of steel plate



Longitudinal (at the top) and cross sections of the vestibule roof and plan of the bulkhead

supported on the underframe, over which is placed one course of ¾-in. 3-ply Salamander insulation. There is an air space between this insulation and the No. 24 gage galvanized steel Chanarch flooring which has ⅝-in. de-



End view of the car showing the box type vestibule with end windows

pressions. This flooring is secured to the floor supports in such a manner as to carry the load independent of the lower or deadening floor. Over the Chanarch is laid a ½-in. layer of Flexolith composition flooring. Around the sides and ends of the car the composition flooring is laid with a cove of about one inch radius to prevent water getting in behind the interior finish when the floor is washed. Next to the exterior side, end and roof sheets is placed a layer of 3-ply Salamander hair felt insulation. Back of the inside finish, below the window stools, one course of ½-in. Salamander is applied. This insulation is covered with cloth on each side and stitched. Insulation is used between the backs of all interior finish sheets and the faces of the framing members in order to break direct metallic connection through the side walls of the cars.

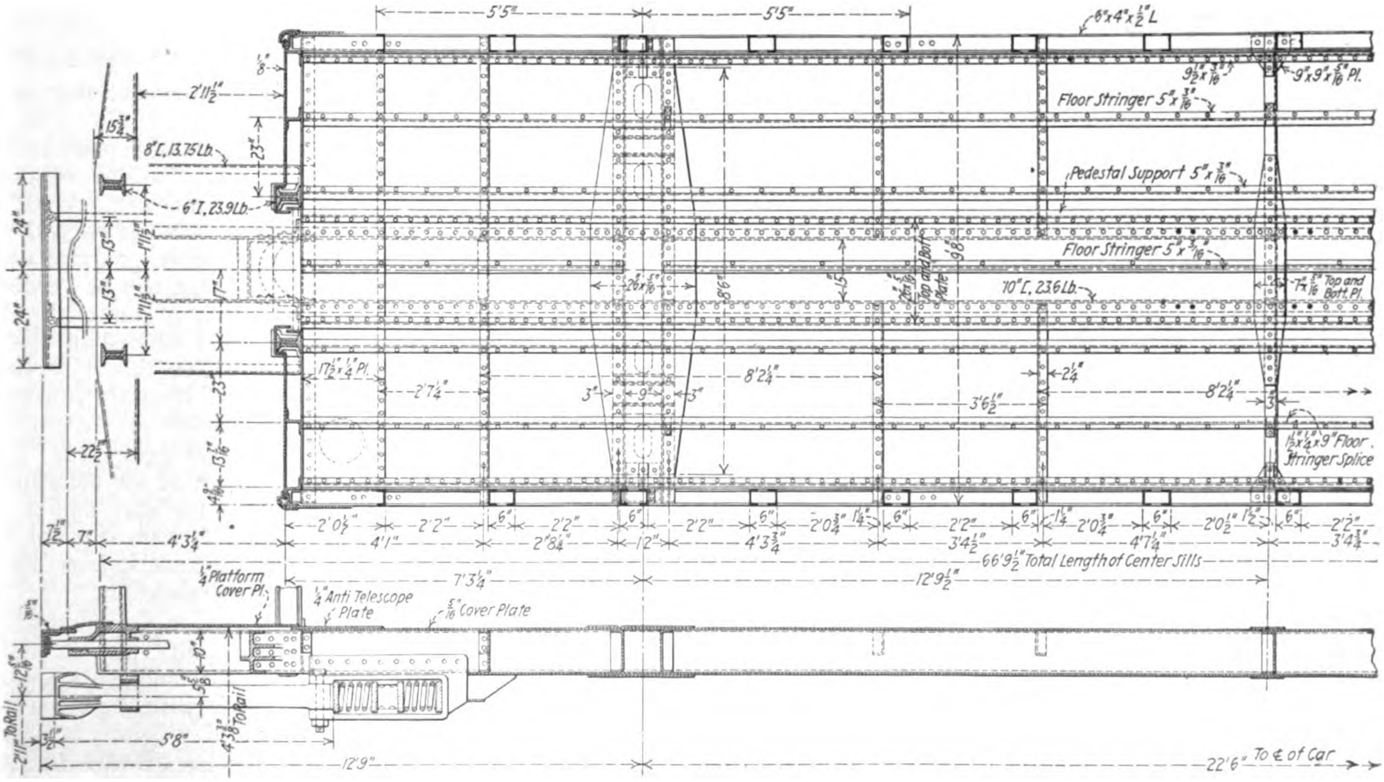
Interior lighting and fixtures

The interior lighting is provided by nine center fixtures fitted with Corona bowls and 50-watt, type "C" lamps. Four flush platform fixtures, one over each step, and one toilet fixture are provided with 25-watt type "C" lamps. The generating equipment consists of a Gould ball-bearing, 30/40-volt generator with body suspension, generator regulator and lamp regulator. A two-compartment switch and regulator panel locker is provided having automatic door-controlled panel lights. The storage battery equipment consists of 16 cells of lead plate battery having a capacity of 200 ampere-hours and housed in a steel battery box.

The latest type of Gold vapor heating system is used in the cars, designed to maintain a comfortable interior temperature. The heating equipment is installed in such a manner that it can be removed at any time without marring the interior and replaced by electric heaters.

The seats are of the Walkover type, manufactured by Hale & Kilburn, with twill rattan fabric cushions and backs and Mexican mahogany arm rests. Continuous steel basket racks are provided. A toilet compartment is built into one end of the car and is furnished with a dry porcelain hopper. Recessed into the toilet room is a water cooler accessible from the car body only.

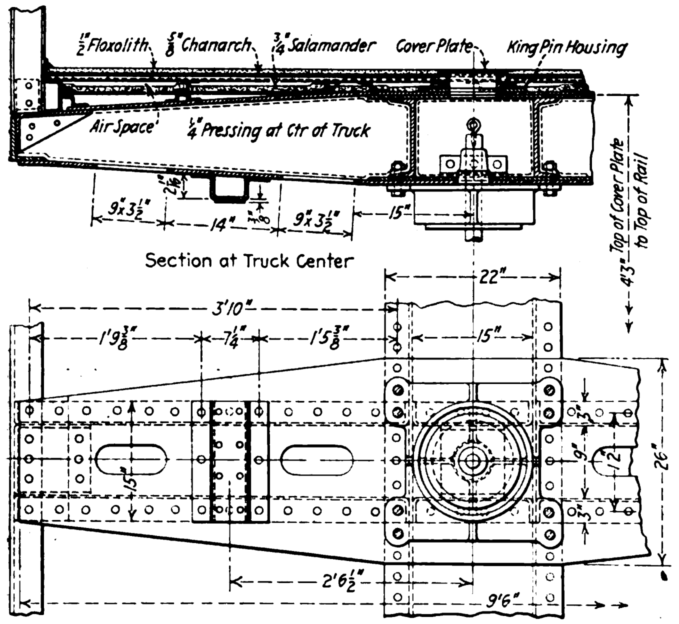
The metal interior finish is surfaced and two coats of light mahogany inside enamel applied. The headlinings



Underframe construction of the D. L. & W. suburban cars

are light in color and protected by three coats of finishing varnish. Gold leaf lettering is used both on the interior and the exterior of the car.

The cars are equipped with the Westinghouse UC air brake equipment arranged for clasp brakes and slack adjuster, to provide a braking power of 90 per cent of the light car weight with a brake cylinder pressure of 60 lb. All brake rigging is designed with ample strength for 105-lb. cylinder pressure. Miner friction draft gear and buffer attachments are used. The couplers are Gould long shank passenger type.



Construction of the body bolster

The trucks are of the four-wheel type with the Commonwealth Steel Company's one-piece cast steel truck frames, cast steel truck bolsters, 5-in. by 9-in. journals and 36-in. rolled steel wheels.

The light weight of these cars is approximately 106,000 lb. and, with a seating capacity of 82 persons, the weight per seated passenger is slightly less than 1,300 lb. The height is somewhat less than existing equipment and the roof structure is designed for the future application of a pantograph and headlights.

The 10 combination passenger and baggage cars mentioned in the first paragraph are of substantially the same design and equipment, having a baggage compartment with an inside length of 17 ft. 3 in. The passenger compartment has a seating capacity of 58 persons. The light weight of these cars is 106,700 lb. and the weight of the two trucks complete is 32,200 lb. Some of the more important dimensions of the coaches are given in the table.

Principle dimensions of D. L. & W. suburban coaches

Length over buffers	70 ft. 6 in.
Length over end sills	59 ft. 6½ in.
Length center to center of trucks	45 ft. 0 in.
Width over side sills	9 ft. 8 in.
Width at eaves	9 ft. 11 in.
Width over clerestory	7 ft. 5⅛ in.
Height from top of rail to top of roof	13 ft. 0 in.
Height from top of rail to bottoms of side sills	3 ft. 6 in.
Height from top of rail to center of drawbars	2 ft. 11 in.
Height from top of floor to ceiling in center of car	8 ft. 3 in.
Seating capacity—coaches	82 persons
Seating capacity—comb. baggage and passenger	58 persons

The maintenance of steel cars*

By J. A. Roberts

Chief A. R. A. clerk, Chesapeake & Ohio

THE subject of steel car maintenance is a vital one to coal-carrying roads that have to rely on foreign roads to maintain their steel cars while off of home lines.

The wooden coal car had been developed to carry 80,000 lb., when the first all-steel coal cars came into use, which were of 100,000 lb. capacity. Many railroads hesitated to adopt the steel car. Car repairers were not trained to remove riveted parts, straighten and reapply. Pneumatic and electric tools were practically unknown, making repairs slow and difficult and many were afraid that the car would rust out in three or four years. But, after a number of them were put in use and it was shown that the earnings from increased capacity of the car alone would pay for the car within three years, the situation then changed and the steel car was adopted by various railroads, until today, it is used on practically every railroad in the country.

The design of steel cars has been improved on to such an extent that some railroads now have such equipment with a carrying capacity up to 120 tons per car. Therefore, you can realize that with cars of this class, necessitating an enormous outlay of money, the equipment should receive every possible consideration in keeping it in first class condition, using facilities for mantenance that will hold the cost down to a minimum.

A record should be kept of the nature of repairs to be made to steel cars, indicating on forms similar to that illustrated, parts that will have to be renewed. With a record of this kind, you can determine what parts will be required for renewal in your heavy repair program and will enable you to order only material that will be needed, thereby keeping down a surplus stock of material. It has been found that steel car material carried in stock for any great length of time deteriorates almost as fast as the material in cars, therefore, it is important to carry in stock as little of this material as possible.

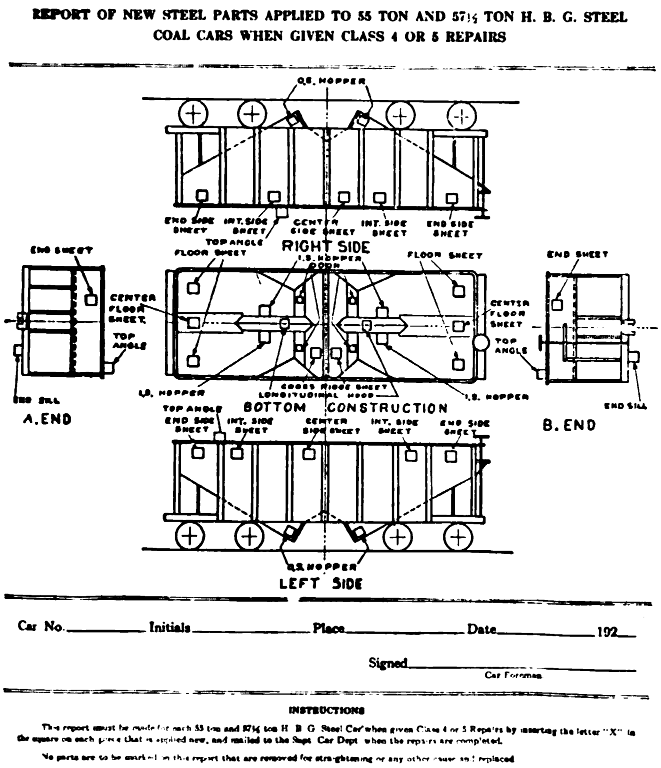
Concerning the deterioration of steel equipment: It has been found that at least 90 per cent of the deterioration of steel cars is on the inside of the cars and it is caused by sulphurous acid in coal. The cars can not be protected on the inside with paint, because it is scraped off in a very short time by mechanical abrasion.

This deterioration could be cut down to a minimum if the cars were used for transportation only, but in many cases, they are used for storage of coal and the sulphur that is found in coal forms a weak acid with the moisture or water in the coal, which, if allowed to stand in a car any length of time, causes the insides of cars to deteriorate quickly. On the other hand, if used for trans-

*Abstract of a paper presented at the annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association at Chicago, September 23, 24 and 25, 1924.

portation only, the coal is in motion, which will not allow the acids to accumulate in any one place, and the motion of coal will keep the metal smooth and free from corrosion. There is, however, some deterioration from corrosion on the outside of cars and it is good practice to scrape off all rust with steel scrapers and wire brushes and paint the cars as fast as they begin to show any amount of rust.

It has been claimed by manufacturers that copper-bearing steel subjected to sulphurous acid will not deteriorate as fast as ordinary steel and quite a few roads are purchasing cars built with copper-bearing steel. It is claimed



Sample form for recording repairs made to steel cars

that steel with .15 to .28 per cent copper will resist corrosion longer than ordinary steel and the American Railway Association, in its recommendations of specifications for steel shapes in Circular DV-282 Exhibit "D," recommends that when copper-bearing steel is specified, the copper content shall not be less than .20 per cent.

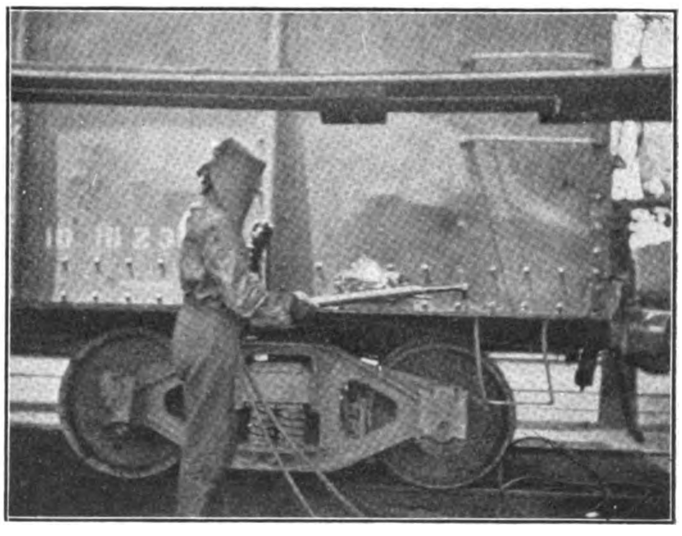
Method of repairing cars

In my opinion, the progressive plan of repairing steel cars should be installed in all principal shops. Roads having sufficient equipment should select cars of the same design and condition for repairs in sufficient numbers to fill out a repair track for as long a period as possible. A car requiring other or more extensive repairs will hold back the cars behind it. Cars of other designs will require more or less time for the different operations and interfere generally with the program. Place the cars on a track after the rivets have been burnt out by an electric burning outfit and specially assigned gangs detailed to do a certain class of work to these cars, until they are ready for the shipping tracks. The different operations will be as follows:

First—The cars are placed on a track equipped with the following electric rivet-burning apparatus—a motor generator set, supplying a direct current not exceeding 80 volts with the necessary capacity in amperes. This is governed by the number of cutting units used. Each cutting unit takes from 400 to 500 amperes. The generator should be located as close to the cutting tracks as possible, to prevent excessive voltage drop. The lead wires from the generator to the cutting stations should have ample cross-sectional area to prevent excessive power loss. In order to prevent the necessity for ladders or movable scaffold, a permanent scaffold should be located the entire length of each side of the burning track about six feet high and having a platform width of about two feet. The framework of this scaffold can be used in place of a pole line for carrying the supply wires, which should have plug-in stations approximately 35 ft. apart. The burning tool consists of a graphite stick held by a suitable handle with sufficient area to prevent excessive heat as a result of the heavy current carried. The rivets in the defective parts are burned out by this process and backed out with nine-inch hammers provided with suitable pneumatic tools. One operator can burn out from 1,000 to 1,500 rivets in eight hours and an operator with a pneumatic tool can back out from 1,500 to 1,800 in eight hours. Comparing this with the rivet-cutting gun, there can be a saving made of approximately 50 per cent in labor and this method does not damage the sheets to any extent, compared with what occurs in using the rivet-cutting guns. If a sheet is thin, the rivet-cutting gun will tear it. This does not occur while using the electric rivet-burning tool. It also practically eliminates accidents due to flying rivets and is a protection to operators.

Second—This operation consists of stripping the car of defective sheets and parts, which should be done before the car is placed on the repair track where it is to be reassembled. This is done in order to keep the working track free from scrap material, which, if allowed to accumulate, is a hazard and will hamper the workmen.

Third—The car is then set on the repair track, trucks



Cutting rivets with electric burning outfit

removed and car body set on tripods, or benches. After the entire line of cars have been jacked up and trucks removed, they are repaired by the following gangs:

Gang No. 1—This can consist of two car repairers and two helpers equipped with special tools. It repairs all trucks and removes and repairs all couplers.

Gang No. 2—One car repairer and one helper. This gang may start in at the same time as Gang No. 1 to straighten all bent parts on the car, set up all flanges and prepare the car for the fitting-up gang.

Gang No. 3—Four car repairers, two apprentices and two helpers. Operation 1—Fitting up all inside and outside hopper sheets, cross ridge sheets and longitudinal hoods. Operation 2—Fitting up all floor sheets, tie beams, side and end sheets. Opera-

tion 3—Fitting up all splices, end sills, body bolsters and all angles.

Gang No. 4—One car repairer and one helper whose duties will be to ream all holes.

Gang No. 5—Two car repairers, one apprentice and one helper. Operation 1—Riveting up all inside and outside hopper sheets, cross ridge sheets and longitudinal hoods. Operation 2—Riveting up all splices, end sills, body bolsters and draft lugs. Operation 3—Riveting up all floor sheets, side and end sheets and all angles.

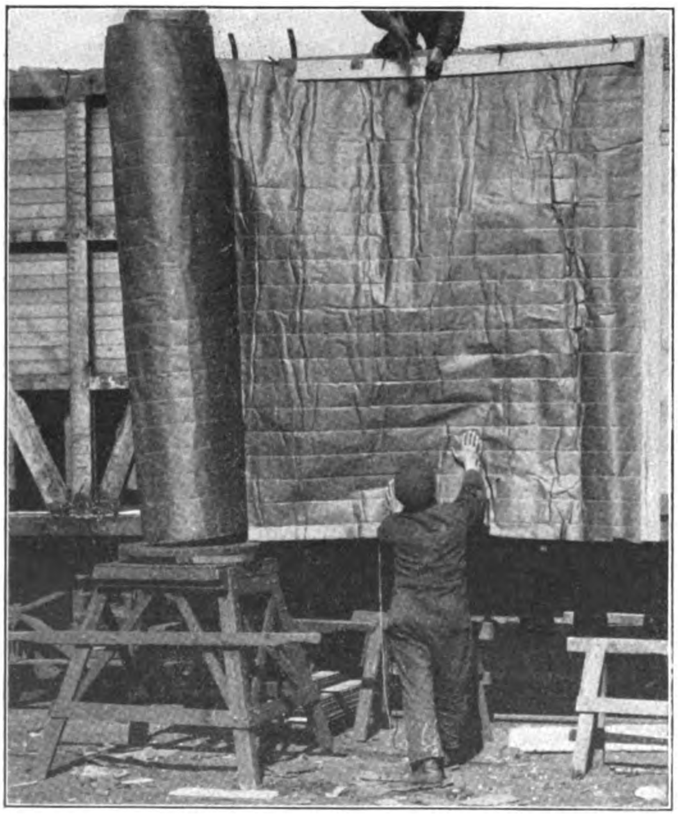
The cars are then painted and stencilled, air brakes tested and thoroughly inspected before being returned to service. Of course, the above gangs can consist of more men, as conditions may require.

Conclusion

If the car is properly repaired, it will give good service for at least 10 years before it will have to be shopped for heavy repairs, unless the car is in an accident, as the floor sheets and outside hopper sheets will last about 10 years before needing renewal, while the side and end sheets will last approximately 15 years before needing new sheets.

Applying insulation to refrigerator cars

THE carrier shown in the illustration has proved to be a time and labor saver in the job of applying insulating felt to the sides of refrigerator cars. It consists essentially of a table, provided with two handles, and a long vertical spindle, which revolves on male and female center plate castings. The table is built high enough so that the edge of the roll of felt comes even with the lower edge of the side sill. The spindle is made from a jack handle, fitted into the base on which the end of the roll of felt rests. The male center casting is bolted to the base of the spindle and it turns on the female center casting, which is bolted to the top of the table. The jack handle extends down through the king pin hole of the center casting about 18 in., so that the lower end will turn in a socket underneath the table top.



The carrier holds the roll of insulation felt in a vertical position so that two men can easily apply it

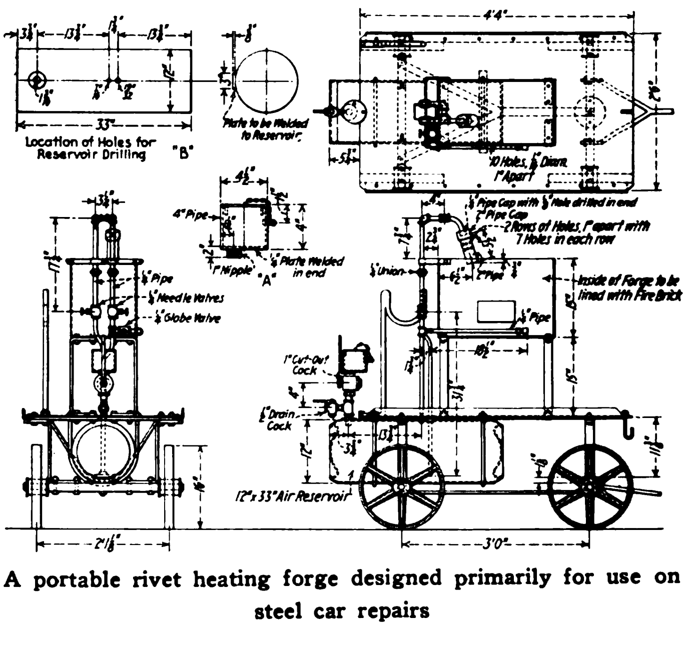
In order to place the felt on the carrier, the roll is laid on the ground, the spindle is removed from the table and thrust into the center of the roll. The table is tipped forward and the pivot end of the spindle is placed in the hole in the table top. The top end of the roll is then raised and as it approaches the vertical, the spindle slides into place in the lower socket.

The carrier is placed so that the felt will unroll on the side next to the car. The end of the felt is secured at the door post and the carrier is then moved along the side of the car and around the end to the other side as the mailing strips are applied.

A portable forge for heating rivets

THE portable rivet heating forge, shown in the drawing, was constructed in the shops of an eastern railroad. It has proved to be useful to the rivet gang engaged in steel car repair work when moving from station to station. The forge is supported on two brackets 15 in. above the bed of the wagon. This arrangement provides space for small tools and rivets underneath the forge, as well as additional carrying space in front of the forge for large tools. A hook over which the air hose can be looped while the forge is being moved is secured to the wagon bed between the forge and air inlet cock, as shown in the drawing.

The apparatus consists essentially of a flat topped



A portable rivet heating forge designed primarily for use on steel car repairs

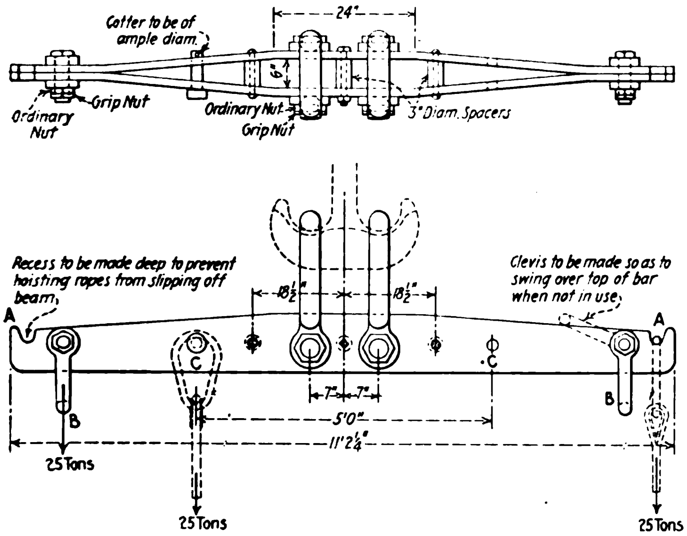
wagon, a 12-in. by 33-in. air reservoir *B*, an oil burner, and a furnace which is constructed of ¼-in. rolled steel and lined with fire brick. Referring to the side view of the forge in the drawing, the air reservoir is filled with fuel oil by means of a cup or funnel, a detailed drawing of which is shown at *A*, the lid is secured by a chain to prevent its being lost. Directly underneath the cup is a 1-in. cut-out cock and a 1-in. by 1-in. by ½-in. tee. This cock must be kept closed at all times, except when

refueling. The air hose is attached at the cock on the horizontal branch of the tee. Compressed air from the shop line is admitted to the oil reservoir as desired by opening or closing this cock. The pressure of the air exerted on top of the oil in the reservoir forces the oil up through a ¼-in. pipe, leading from a point near the bottom of the reservoir, to the burner. Air for atomizing the oil is taken from the top of the reservoir by a second ¼-in. pipe which is joined to the fuel oil pipe by a tee which is located about 15 in. above the bed of the wagon.

With the exception of the wheels, which are of gray iron, pipe fittings and burner, all of the various parts used in the construction of the apparatus are of forged or rolled steel. Two 2-in. by 2-in. by ¼-in. rolled steel angles from the sides of the wagon bed. The oil reservoir hangers are made of ½-in. round bar, bent U-shaped and threaded at the ends. The wagon tongue is forged from ½-in. by 1½-in. flat bar and is 37½ in. long. A hook is provided for holding the wagon tongue up out of the way when the forge is not being moved.

Hoisting beam for wreck cranes

It is essential that a variety of hoisting equipment necessary to meet the numerous conditions encountered in clearing up wrecks be provided on the wreck train. The hoisting beam, shown in the drawing, is included in the wreck crane equipment on an eastern railroad. It is not only suitable for wrecking service, but may be also included as a part of the crane equipment in the locomotive erecting shop. The beams are of wrought



Hoisting beam suitable for either wreck crane or locomotive erecting shop service

steel designed to carry a load of 50 tons with a factor of safety of five.

Any of the link or cable combinations, such as *AA, BB* or *CC,* may be used as desired. However, no combination, such as *AC* or *BC* on opposite sides of the fulcrum may be used on account of unbalancing the load on the beam. The two sections which compose the beam are held apart at the center by means of hollow spacers held in position by coupler yoke rivets. Care should be taken to make the recesses at the ends of the beam deep enough to prevent any possibility of the hoisting ropes slipping off the ends.

Convenient ladders for the coach cleaners

A LADDER is undoubtedly, the most important part of a coach cleaner's equipment. Possibly, the best type of ladder for this work is one having a step wide enough to support a part of the heel and ball of the foot. A step similar to the ones illustrated, provides a

This type of ladder provides a substantial support to work on —Note that the box is open at the top, making it convenient of access

more substantial footing for the cleaner and he feels safe while using both hands in his work. Furthermore a ladder with wide steps is not so tiresome to the feet as a rung ladder.

The coach cleaner's ladders, shown in the illustration,

Front and rear views of a coach cleaner's ladder, showing the side opening to the box and the pad on the back to prevent scratching

are examples of the kind used on the Delaware, Lackawanna & Western at its Hoboken, N. J., terminal and in the coach yard at East Buffalo, N. Y. They are not only built with wide steps, but boxes are also provided for holding cleaning materials. After the cleaner has once started to work, it is unnecessary for him to descend the ladder until the job is completed or the ladder has to be moved further along the car. Pads are placed on the back to prevent scratching the side of the car.

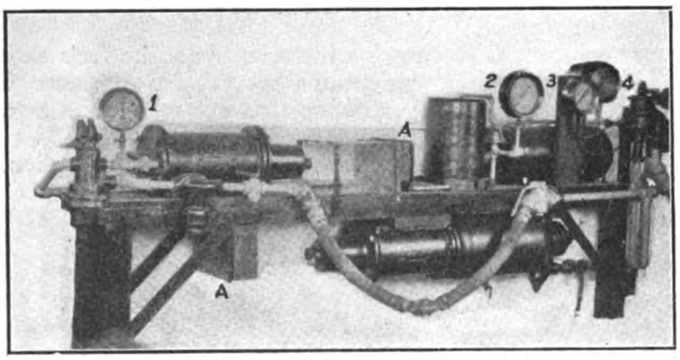
Air brake equipment at Rice Institute

By J. H. Pound

Assistant professor, mechanical engineering, Rice Institute, Houston, Tex.

During the past winter the mechanical engineering department at Rice Institute, Houston, Tex., constructed an arrangement of standard air brake equipment for the purpose of demonstrating the principles and routine operation to engineering students. On account of crowded laboratory conditions it was necessary to build the apparatus so that it would occupy a very small space.

This apparatus consists of a driver brake cylinder and detached auxiliary reservoir with a plain triple valve and double spring retaining valve, a standard combined freight car cylinder and auxiliary reservoir with a quick-action triple valve, and an engineman's brake valve complete with feed valve, equalizing reservoir, and duplex gage. The brake pipe contains the usual cut-out cocks, centrifugal dirt collector and hose connections. This equipment



Air brake apparatus constructed for purposes of demonstration to technical students

is mounted on a heavy wooden bench made of 4-in. by 12-in. timber, as shown in the illustration. Compressed air is supplied by a single stage, steam-driven locomotive type air compressor provided with a governor and main reservoir which had previously been installed in the laboratory.

When air is admitted into the brake cylinders, the thrust of the pistons is taken by the 8-in. steel angles *A* which are faced with hard wood and bolted securely to the bench. The pressure changes in the main reservoir and train pipe are recorded from the duplex gage. Gages *1* and *4* show the pressures in the driver brake cylinder and detached auxiliary reservoir during the various operations, which are performed both with and without the pressure retaining valve cut in. Gage *2* is connected to the auxiliary reservoir of the freight car cylinder and serves to show the difference in equalizing pressure existing with plain and with quick action triple valves after an emergency application. An emergency application is made by disengaging the hose coupling. The travel of the driver brake piston sleeve is protected with a wire guard.

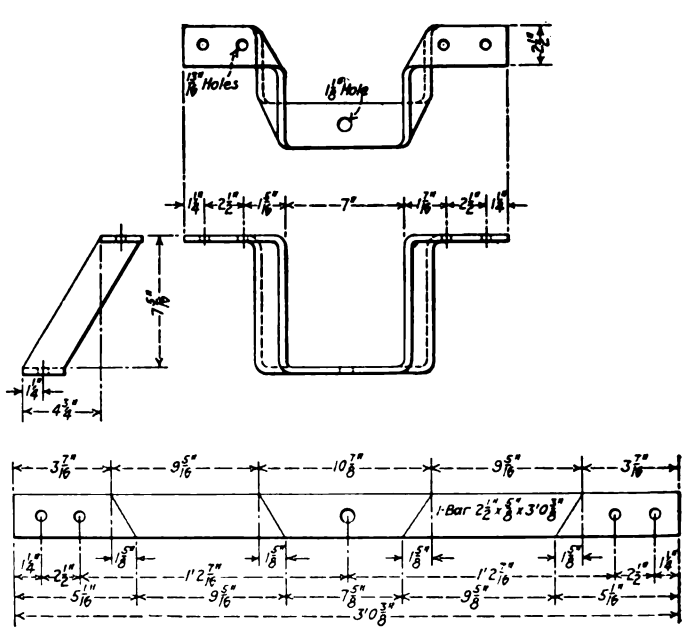
The instructor in demonstrating goes through certain operations which are briefly described on a mimeographed form supplied to each student. The readings of the gages during these operations are noted and recorded in blank spaces on the form opposite the description of the changes made in the brake valve positions. The student is required to write a description of the action of all the mechanisms involved in the operation he has witnessed. By means of this demonstration and a written report, the students get a much better idea of the operation of an automatic air brake system than they got by the old method of instruction.

This apparatus occupies a floor space approximately 17 in. by 9 ft. 8 in. It could probably be assembled at any school, from new parts, at a cost of between $200 and $225. Such equipment in a laboratory furnishes a means of demonstration of the possibilities of compressed air as a control medium which is useful even in engineering schools where special courses in railway mechanical engineering are not offered.

Forming brake shaft steps from cold stock

By Harry R. Taube

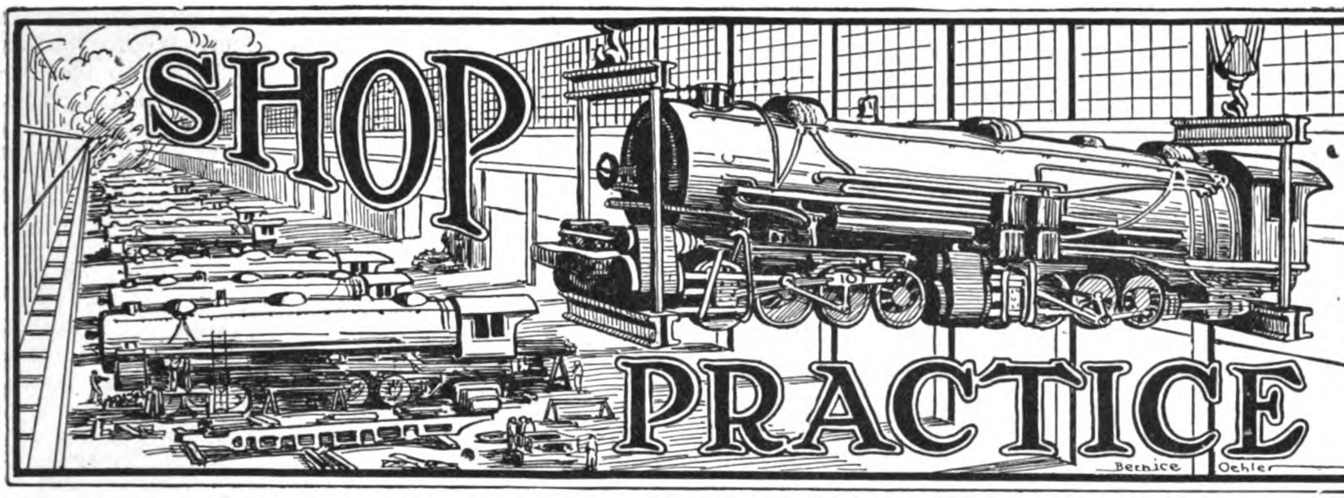
The accompanying illustration shows a method of cold forming brake shaft steps which has been developed in the Palatino shops of the American Steel Company at Havana, Cuba. The ordinary run of steel stock is used. In following the dimensions on the lay-out, it will be noted that the angles are laid obliquely,



Lay-out of stock for brake shaft steps preparatory to cold forming

as the purpose of this is to permit the offset to be formed by cold bending across the flat of the material rather than by hot bending edgewise.

This job can be done on a bulldozer in one set up. The ram forms the bottom of the bracket while two expanding toggles form the lugs. As the cost of fuel is high in Cuba, a considerable saving is effected by this method.



Case carburizing and hardening valve motion parts

The steel, carburizing agent, temperature and time element are essential factors

By J. E. Burns, Jr.
Member, research staff, E. F. Houghton & Co.

THE object of case carburizing and hardening valve motion parts is to secure a hard wearing surface on low carbon steel or iron, and the retention of toughness in the core of the metal used. The process can be roughly divided into two distinct operations, namely: the carburization or cementation of the surface by which the carbon content is sufficiently raised to insure the abrasive value and hardness desired, and to provide for a suitable heat treatment which will develop the desired physical characteristic of both the case and the core. The complete operation should not only result in obtaining a very hard case, but also non-brittleness in the core, thus producing link motion parts, which shall possess a minimum fragility and a maximum abrasive (hardness) value.

Essential factors in carburizing operations

The following four factors must be appreciated in detail if satisfactory valve motion parts are to be produced. They are the steel, the carburizing agent, the temperature and the time element.

The character of the steel or iron used for motion work is governed, in no small measure, by the fact that one of the essential factors is to eliminate brittleness in the core. It is an accepted engineering fact that the higher the carbon the greater the brittleness, particularly when the carbon content is .25 per cent or over. Furthermore, as practically all commercial carburizing practice is followed by one or more heat treatments for toughening and hardening, it follows that the use of steel with a high carbon content will also increase brittleness in quenching. For these reasons it is apparent that the carbon content in motion work should be low. On the other hand if the carbon content is too low, extreme difficulty is encountered in the machining operations. The low carbon results in a very mushy and rough surface, necessitating a greater depth of case than otherwise would be necessary to allow for the increased grinding tolerances necessary in order to secure a smooth surface after the hardening operation. For the above reasons the general American practice is to adopt a carbon content of approximately .10 to .20 per cent, .15 per cent being the desired amount.

From .30 to .35 per cent manganese is considered most desirable, as it is a well established fact that a higher manganese content renders the steel, as a whole, more sensitive to rapid cooling, while increasing the hardness of the case causes a corresponding and detrimental stiffening of the core.

The impurities, silicon, sulphur and phosphorus, should be just as low as is possible to secure in commercial steels as slag, blow holes, and segregations should be entirely absent.

Carburizing agent

Carburizing or cementation by its very nature demands the presence of free carbon in some form or another; either in a solid body or by the presence of a gas which will liberate free carbon by the process of decomposition. The mere presence of free carbon by contact with iron or steel will not satisfy the conditions for successful carburizing.

Science tells us that compounds evolving carbon monoxide or hydro-carbon gases alone have definite outstanding advantages, but for commercial endeavor they have many objectionable features. Combinations of compounds insuring the evolving of both these gases produce the most satisfactory medium for general commercial work, and such compounds are considered standards in many large industries.

Wood charcoal, which is sometimes used in the presence of a catalytic agent, has a definite tendency to develop

cemented zones of low and irregular carbon content. It also causes internal combustion in the carburizing pot, making it impossible to control the carburizing temperature. This is an objectionable condition as temperature, in the largest measure, controls the carbon content.

Animal charcoal such as charred leather, bone, horn, etc., are objectionable in themselves as carburizing agents. Grayson has produced incontrovertible evidence that sulphur will diffuse into iron or steel at temperatures used for carburizing with such substances as above mentioned, and that this sulphur combines with manganese and iron to form manganese and iron sulphides resulting in soft spots.

Referring to Fig. 1, it will be noticed that there appear on the edges large quantities of sulphide of manganese and also sulphide of iron with ferrite crystals intermingled. This sulphur diffusion is serious in valve motion work, because it produces soft spots, and when present in smaller quantities, will have a tendency to cause chipping of the case, thus producing two objectionable effects which should be avoided if satisfactory service is to be expected. Hence, any compounds manufactured by reliable commercial firms are much more to be desired than questionable home-made products.

The compound yielding both hydro-carbon and carbon monoxide gases in fixed percentages will insure satisfactory results, all other factors being equal. It is the experience of manufacturers that it is impossible to manufacture a carburizing material which will give uniform results, unless the energizers are attached to the grains of the carbon, either by impregnating or binding. The most uniform results are obtained from a compound made of grains of charcoal leather and wood charcoal suitably impregnated with energizers and then baked. Such a compound, when first used, will char the binder which will hold the energizers to the grain, thereby producing continuous uniform results, during the life of the compound. Such a compound evolves both carbon monoxide and hydro-carbon gases and is preferable to all others for general railroad purposes.

Temperature and time factors

Carburizing gases, by diffusing into steel, precipitate free carbon. This carbon, under suitable condition, will be dissolved at once by the iron, forming a true steel. The solubility of this carbon depends upon the temperature. If a piece of steel desirable for motion work, containing from .10 to .20 per cent carbon, is heated, none of the Cementite, which is mechanically mixed with Ferrite (iron) to make the mixture Pearlite, is effected until the lower critical temperature (1,350 deg. F.) is reached. At this temperature, the iron of the Pearlite changes and dissolves the Cementite, the two forming a solid solution called Austenite. As the temperature is progressively raised, more of the excess iron is dissolved by the Austenite until the so-called Ac 3 range is reached. At this point the entire mass of steel consists of Austenite.

It is thus possible for carburization to take place at temperatures between the Ac 1 and the Ac 3 ranges (the lower and upper critical points). The carburizing action, however, must necessarily be not only slow, but also irregular and non-uniform. The minimum temperature used should not be lower than the upper critical range, approximately 1,625 deg. F. The recommended furnace temperature is 1,700 deg. F.

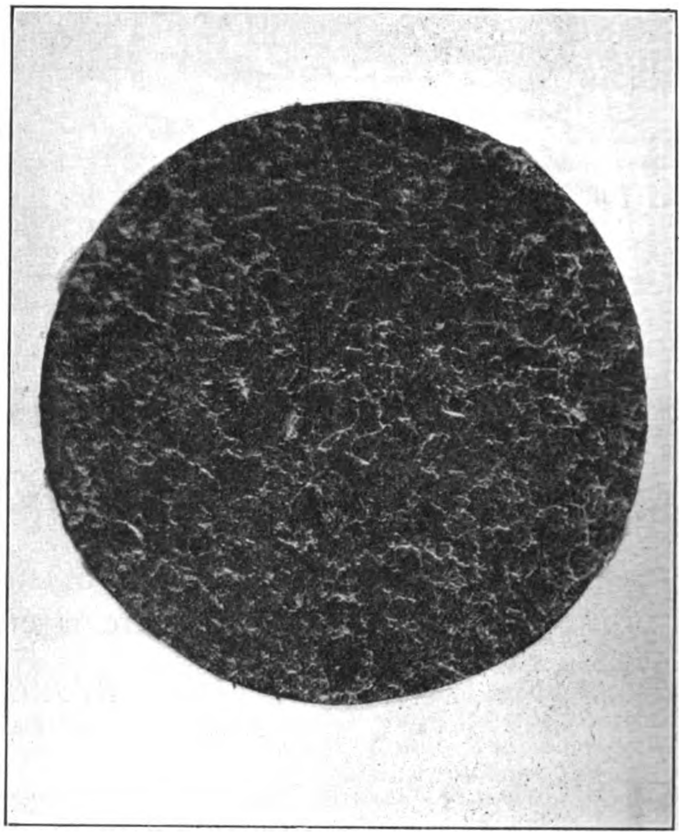


Fig. 1—Hypereutectoid case showing improperly deoxidized or abnormal steel—The small, curly, but numerous ridges of excess cementite indicate that the steel is of poor quality

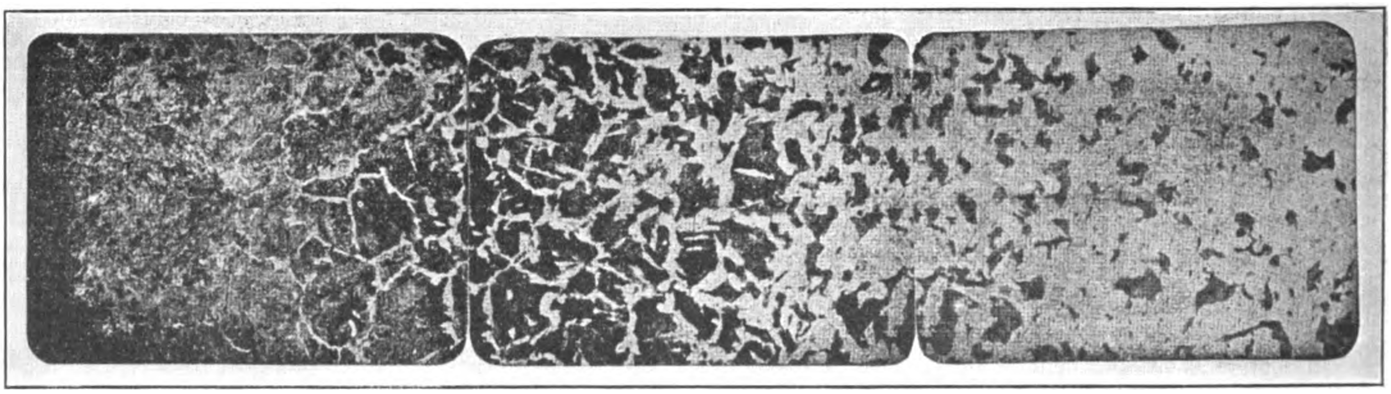


Fig. 2—At the left is shown a carbonized case of 90-point carbon—Remaining sections show graduation of the carbon from the case into the core

All commercial carburizing processes must provide a depth of case which will satisfy the requirements. Thus

valve motion parts should have sufficient depth to allow for any grinding and the low allowable limit for serviceable use.

Depth of penetration is regulated by the time factor

With a definite depth in view, economic considerations require that the velocity of penetration shall be definitely known in relation to the factors of time, temperature and carburizing agent. It is generally understood that the depth of penetration and carbon content increases with the temperature and time elements. A properly carburized valve motion part should show a gradual decrease in carbon content from about one per cent on the surface to that of the initial content in the core of from .10 to .20 per cent. This structure is shown in Fig. 2.

The case should develop traces of hyper-eutectoid structure (.95 to 1.00 per cent carbon). This will insure the proper development of the desired hardness without danger of enfoliation (chipping of the case). Fig. 3 shows the development of this granular formation.

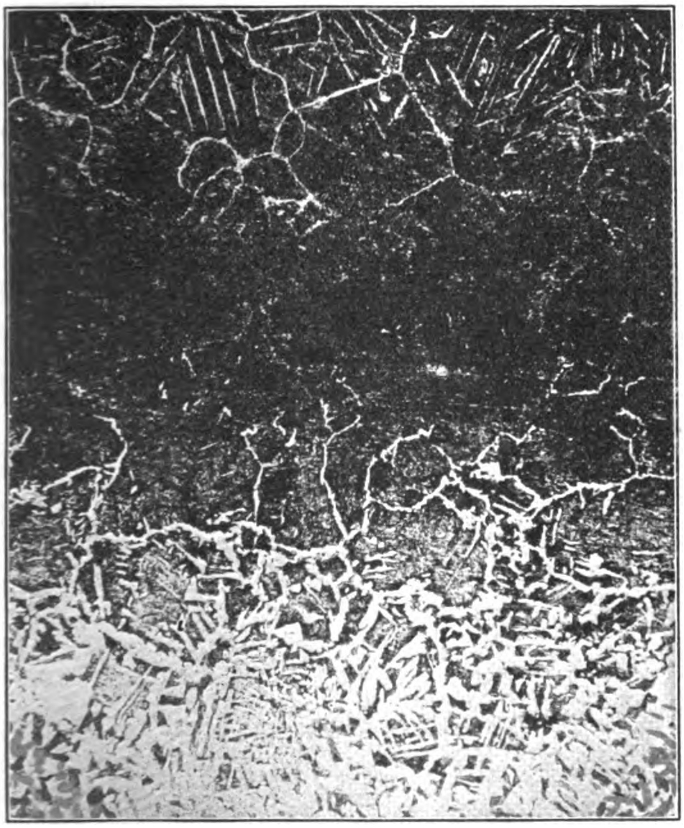


Fig. 3—Hypereutectoid case of normal steel showing, at the bottom, a network of cementite around the grains of lamellar pearlite—The network at the top indicates traces of the hypereutectoid structure—The dark area in the middle is the eutectoid zone

The hyper-eutectoid structure starts to develop at the point of saturation and at temperatures about 1,700 deg. F. The eutectoid zone is the saturated condition and hypo-eutectoid is indicative of non-saturation, which is shown in Fig. 2. Both the hyper-eutectoid and the eutectoid zones will develop maximum hardness. The hypo-eutectoid zone (lower than .90 per cent carbon) cannot insure this condition. Low carburizing temperatures invariably develop the hypo-eutectoid structure and are often the direct cause of soft work. Valve motion work should be carburized at a furnace temperature of 100 deg. above the Ac range (1,700 deg. F.). A desirable compound will insure the development of the eutectoid range with traces of hyper-eutectoid structure.

Chipping of the case

Enfoliation is a condition where flasking, chipping, and often peeling of the case is noted. Microscopic and chemical investigations indicate definitely that this line or plane of weakness characterizes the separation of the hyper-eutectoid zone from that of the hypo-eutectoid. In order to avoid this condition, it is necessary that the temperature factor be controlled, insuring no excess of carbon being developed (hyper-eutectoid) beyond the traces previously mentioned. Hence, it would be unsafe to use temperatures over 1,700 to 1,725 deg. F.

It has also been pointed out in an article dealing with the heat treatment of spring steel which appeared in the February issue of the *Railway Mechanical Engineer,* that temperatures materially above the Ac 3 range cause an increase in the grain growth with decrease in toughness. This is indicated by the following table compiled by Guillet:

Temperature, deg. F.	Impact-test Kilograms-meters
1470	26
1560	28
1650	15
1740	12
1830	7
1920	3
2010	4

It is thus obvious that any heating over a protracted period at temperatures above the upper critical range (Ac 3) greatly lowers the resistance of steel to impact or shock.

Carburizing boxes

The selection or design of a box or container for carburizing should be given the utmost consideration. In the attempt to secure a uniform case much thought and research has been given to the selection of steel, carburizing agent, and the degree and duration of heating. All this, in many instances, has proved unavailing.

It must be remembered that the inside of a box requires considerable time to acquire the furnace temperature, and in a large box such as is used for valve motion parts, the material in the center lags behind the indicated furnace temperature several hours or its temperature equivalent of several hundred degrees. No manipulation of the furnace can change this effect. It can only be remedied by altering the dimensions of the box itself.

Here, then, lies one explanation of many failures of valve motion work. The box should not be larger than is absolutely necessary for motion work and should be narrower in at least one dimension than in the others so that the heat has a chance to penetrate quickly from at least two sides and reach all the contents at about the same time. The box should not be made too deep in proportion to the other dimensions, that that bushings and pins can be packed in the same box. The design of the box should follow the outline of the link in rectangular form, allowing approximately 3 in. on all sides for clearance and packing.

For railroad work, suitable boxes can be made from boiler plate, electrically welded or suitably riveted. Cast iron boxes are not satisfactory as their life is comparatively short. The cover should fit as close as is practical and legs should be provided to insure radiation of the heat from the bottom of the box.

Carefulness in packing is fundamental for good practice and uniformity of results, just as much as carefulness in heating or treatment. The method of packing should be such as will insure as nearly as possible the even heating and uniform carburizing of all parts of motion work in the same box. Heavy pieces such as links do not

require the same amount of care as the smaller pieces.

The first step in the general operation of packing is to cover the bottom of the box with compound to a depth of 1½ to 2 in. The link should then be placed firmly on the bed so that the compound and work are in close contact with each other. The bushings and pins should be placed at such points in the box as will prevent contact with each other or with the sides of the box and should be separated by at least 1½ or 2 in. of compound. An insufficient amount of compound will cause non-uniformity of results; a little too much is more advisable than too little.

The top layer should have at least 2 in. of compound sprinkled over it. When the box is fully packed, the cover is placed on the box and the edges carefully sealed with fire clay. The box is now ready for the heating operation.

Furnace design

There are a number of furnaces satisfactory for carburizing work but it is not the intention to recommend any particular make but to confine this discussion to the general design. Three main points are to be considered:

1—The furnace should have a capacity of attaining the maximum temperature necessary.

2—It must obtain a thoroughly uniform heat application at any of the intervening temperatures and be capable of maintaining that temperature with little or no variation.

3—The atmosphere in the furnace should be non-oxidizing so as to protect the box and work where reheating operations are performed.

Under-fired furnaces, developing indirect combustion, are most generally used and have proved very dependable.

Thermal temperature

Link motion work that has undergone the carburizing process previously described, requires a subsequent heat treatment. As one of the essential aims of carburizing valve motion work is to produce a hard abrasive surface, and as carburized links and parts, when slowly cooled from the carburizing temperature, are lacking in this quality, it is evident that a hardening process is necessary. Where the carburizing temperature has not exceeded 1,700 deg. F., the grain growth in the links and the pins is not of sufficient importance, in consideration of their cross section area, to warrant the expense of a double treatment. We will, therefore, confine our discussion to the heat treatment of the case. Bushings, due to their comparatively small cross section, should be double heat treated and will be discussed separately.

When the carburizing process is completed, the links should be allowed to cool in the box, then replaced in the furnace and heated about 1,450 to 1,500 deg. F., and quenched into running cold water if maximum results are desired. Owing to the design of the link itself and the necessity for having a hard abrasive surface in the slotted area, it is necessary that some means be provided to insure a constant flow of water within this area during the quenching operation. If the link is immersed into the quenching tank without this precaution, vapor pockets are invariably created, causing a slow radiation of heat, which in turn prevents the developing of Martensite or the hardening constituent of steel. Soft links, where complaints have led to investigation, in a great number of cases have been attributed to this one cause.

It has been a more or less common practice to quench the links direct from the carburizing temperature. Satisfactory hardness can be secured, but at the expense of the grain growth in the case, which has a marked tendency to cause chipping. If the consideration of chipping is not of serious importance, considerable time and expense can be eliminated by the direct quenching method and a satisfactory, serviceable link secured.

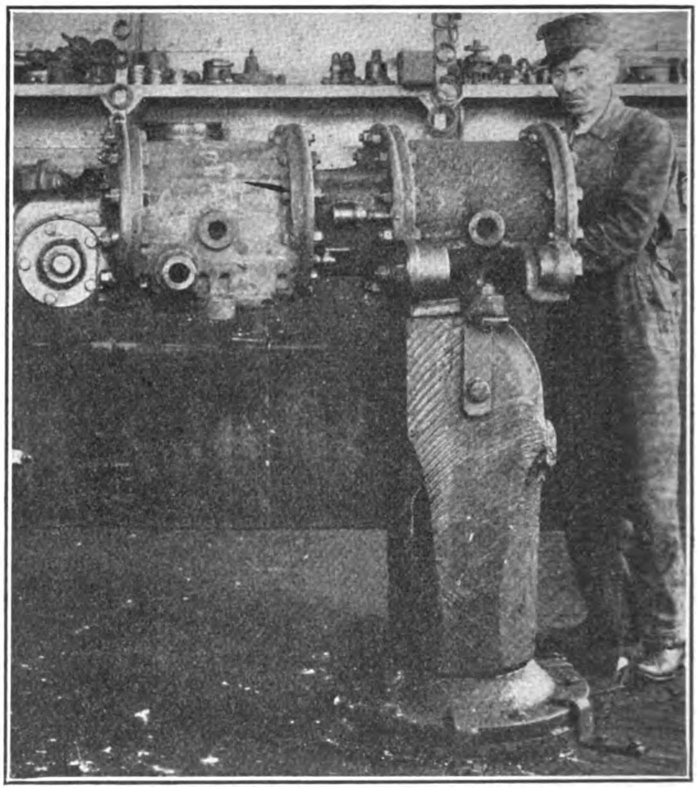
Pins may be processed in the same manner, provided failure of the pin is not indicated by fracture. If pins are rendered unserviceable from this cause, a double heat treatment will materially increase the fatigue resisting characteristics.

This double treatment is as follows: After carburizing, reheat the parts to 1,600 to 1,625 deg. F., quench in oil, and then reheat to 1,425 to 1,450 deg. F. and then quench in water. This treatment will develop the maximum physical characteristics possible. If abrasive value or hardness is the most necessary requisite, a direct quench from the carburizing temperature will serve.

Bushings at all times should be double heat treated as follows: After carburizing, reheat to 1,600 to 1,625 deg. F. and quench in oil; then reheat to 1,425 to 1,450 deg. F. and quench in water. This will insure a tough bushing with a maximum hardness and abrasive value.

Handy bench for repairing air pumps

An improved type of bench for repairing air pumps is described in the June 15, 1924, issue of the Mechanical Department Bulletin of the Kansas City Southern. It was designed by Charles Mays of the Shreveport, La., shops. Formerly an ordinary repair bench was used for air pumps undergoing repairs, which

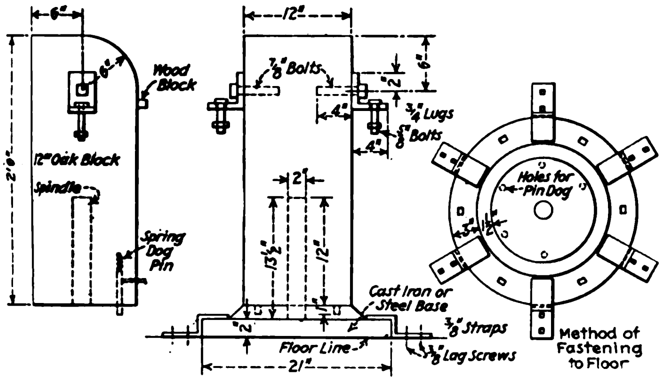


An air pump bench that may be rotated to any position desired and which permits the mechanic to work underneath

made it somewhat inconvenient to perform the work. It also required the assistance of a helper to place the pump on the bench and get into a convenient position for the mechanic to work on.

In order to eliminate this difficulty the bench shown in the sketch has been devised. It consists essentially of an

oak block 12 in. square by 2 ft. 6 in. high which is pivoted on a cast iron or cast steel base. The base is secured to the floor by means of ⅜-in. lag screws. Brackets for holding the pumps are bolted to the block 6 in. down from the top by means of ⅞-in. bolts, and ⅝-in. bolts are used to secure the lugs of the air pump to the brackets,



Sketch of bench for repairing air pumps

as shown in the illustration. The pump may be swung down to a vertical position from the horizontal position shown.

Pumps are placed on the bench by means of an air hoist. A saving of nearly 25 per cent over the former method has been accomplished by the use of this bench for repairing air pumps.

Welding locomotive frames with bronze

By J. H. Chancey

Blacksmith foreman, Georgia Railroad, Augusta, Ga.

SEVERAL inquiries have been made by those interested in the subject of bronze welding for locomotive frames. Inasmuch as there are now on the Georgia Railroad, nine frames welded by the Tobin bronze acetylene process, which have been in continuous freight and passenger service from three to nine months, our experience may be of value.

When the subject of welding frames with the bronze method was first suggested by a demonstrator, the writer was reluctant to attempt it. However, after being assured that it was possible to weld the bronze to steel or iron so that the bronze would break before tearing loose at its welded surface, this method of welding locomotive frames began on the Georgia Railroad.

In relating our experience to a number of persons, such a lack of confidence and disapproval was manifested that it was decided to test the process out in our own way, and so authority was given for the tests to be made. The results of these tests are given below.

Test No. 1—Two pieces of Tennessee bloom iron, 4¼ in. by 4¼ in. by 12 in. long, were welded together by the acetylene process, using ¼-in. Tobin Bronze filler. This test piece was then placed in a wheel press in such a position as to allow the press ram to bear directly against the center of the weld. The test piece started bending at 75 tons pressure and bent 2 in. out of center at 100 tons pressure. The pressure was released at 100 tons and the test piece was reversed and the pressure reapplied. It started bending at approximately 100 tons, bent 1¾ in. out of line and cracked one-half way through the center of the weld at 125 tons pressure.

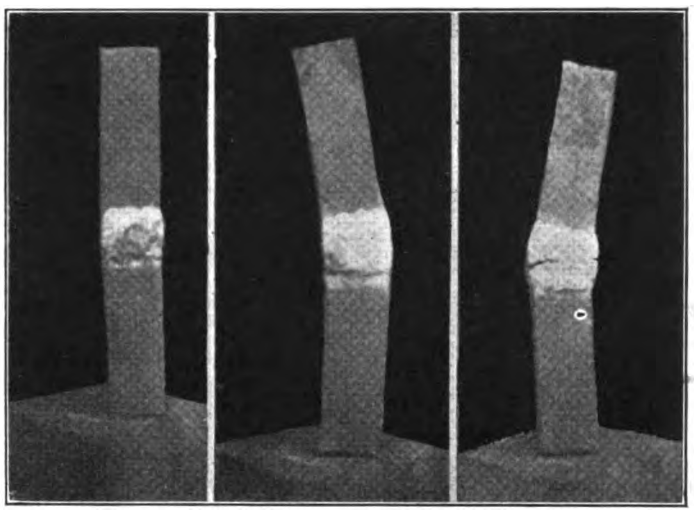
Test No. 2—Two pieces of material of the same grade and of the same dimensions were welded by the acetylene process with ¼-in. Norway iron filler. The piece was tested in the same manner and it started bending at approximately 70 tons pressure and bent 2 in. out of line at 100 tons. The pressure was released at 100 tons, and on the reverse pressure it started bending at 95 tons; bent 1½ in. out of line and cracked one-half way through the center of the weld at 110 tons pressure.

Test No. 3—Two pieces of material of the same grade and of the same dimensions were welded by the acetylene process with No. 1 patented steel ¼-in. filler. Using the same method of testing, the piece started bending at approximately 80 tons pressure, bent 1½ in. out of center and broke entirely through the center of the weld at 100 tons pressure.

Test No. 4—Two pieces of the same grade and of the same dimensions were welded by the electric process with 3/16-in. filler and when tested, started bending at 85 tons pressure, bent 1¼ in. out of line and broke in two pieces at 100 tons pressure.

From these tests the reader will note that the bronze weld surpassed all others by a margin of 15 tons, and the writer is thoroughly convinced that the bronze weld for locomotive frames is superior to autogenous welds with any other material he has thus far used.

In making these test welds, full access was afforded for



The results of testing a Tobin bronze weld

the testing of expansion and contraction, and it was found that the bronze weld contracted only 3/64-in. after entirely cooling off. Therefore, the bronze weld eliminates the frame problems we are confronted with, where it is almost out of the question to get the required expansion, other than by electric welding. Still another feature in favor of the bronze weld is that it can be completed in approximately one-half the time required in using any other filler, which necessarily results in quite a saving.

The following precautions should be taken when making a bronze weld. Cut the vee to a sufficient angle to give the necessary torch play, taking pains, of course, not to get it too large. Use as small a vee as possible so as to obtain a quicker, better job with less expense for material, labor, etc. Chip the welding surface of the frame as clean as possible, and last, but not least, get the best obtainable operators on the job.

On October 15, 1924, we welded a 4-in. by 5-in. top rail in front of a main driver without removing any parts and also allowed for no expansion. This job was completed in 30 min. after the torch was applied, using No. 10 tips. The entire cost of this operation, including labor and material, amounted to approximately ten dollars.

Repairing driving boxes in the average size shop*

By H. H. Henson
Machine shop foreman, Southern, Chattanooga, Tenn.

THIS is the most important key job in the railway locomotive shop. All of the different parts are usually ready to be assembled on the locomotive except the driving boxes. The machinist cannot lay off the shoes and wedges until he gets the driving box sizes. After the driving boxes are ready for the locomotive, everything moves along rapidly. Every machine shop foreman has some different idea of performing the different operations involved in this work. Some still cling to the old method of many years back.

The shop in which the writer is employed is not the largest on the system, but probably our method of handling driving boxes, may be of interest to some foremen in locomotive shops of a similar size. The practice adhered to in this shop is to keep one full set of driving boxes machined all over, ready to be bored for each class of locomotive which we have, besides extra boxes for the drop-pit repairs. This method insures a full set of boxes for the engine that is first due out of the shop. Boxes are always on hand ready to bore as soon as the wheels are dropped on locomotives in for light repairs.

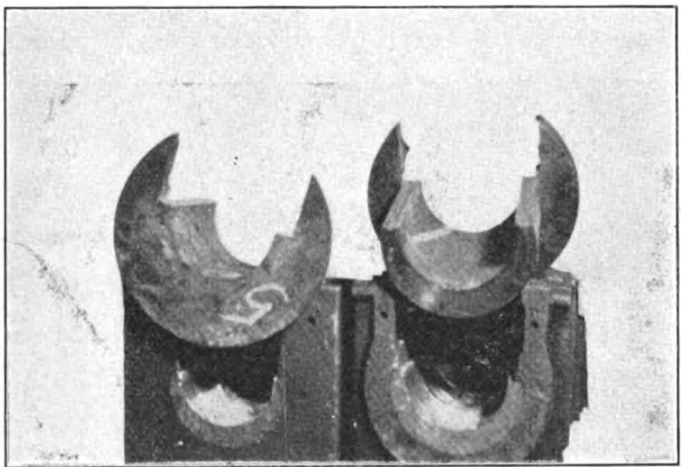


Fig. 1—Flanged driving box brasses

As soon as the locomotives in the erecting shop are stripped, all boxes are cleaned with oil and waste or sent to the lye vat. After passing through the cleaning process repair work is started at once on the set of boxes so as to have them ready for the next locomotive of that same class. The boxes are first examined to see if any have to be replaced on account of defects. The lead man of the box gang checks up the box sizes to see if any are undersize, and if he finds any, a record is taken after which they are sent to the electric welder to have slabs welded on, thus building the box up to conform to the standard size.

Method of applying brasses

Instead of pouring on the brass hub liner into the counterbore of box, as is done in some railroad shops, a brass is used that has the flange or hub liner cast in one piece which gives much better satisfaction than the old type. The driving box is prepared for this brass by counterboring the hub side of the box 3/8 in. deep, and making the diameter to suit the size of the box. These brasses are very easily handled, as they require no special chuck or mandrel to machine them. They are machined on a 36-in. Niles heavy duty engine lathe. The lathe hand can turn the brasses to fit the crown in the driving box, as fast as the shaper hand can lay off and machine the sides of the brass preparatory to pressing them in the box. Fig. 1 shows one of the flanged type brasses in the rough casting, ready to be machined. This is done by placing only the flanged section in the ordinary lathe chuck.

After the brass has been machined and pressed in the driving box, it is then ready to have the shoe and wedge sides faced on the planer in the usual way. After the planing operation, there is drilled in the top or crown of the box and brass a hole, 1 1/4 in. or larger, depending upon the size of the driving box. This hole is then reamed with a taper reamer from the inside of the box, and a taper brass pin driven in with a sledge hammer. Oil holes are drilled through the face of the hub on the box into the oil cellars in the top of the driving box, to lubricate the hub-liner.

The boxes are now ready for the vertical boring mill, on which the hub sides of the flanges are faced to the required thickness for the lateral motion between the wheel centers and the hub sides of the boxes. The boxes are held on the boring mill table by means of a two-jaw universal chuck. The boxes are then taken to the heavy duty Niles horizontal boring mill to be set up, and bored as in Fig. 2. It will be noted that an expanding double-cutter boring tool is used which bores the box in 30 to 45 minutes, depending on the size of the journal. Only two cuts are taken, a roughing and finishing cut. The cutters are made of high speed steel, 1/2 in. by 1 1/2 in. in size and lengths to suit. Two boxes are set up on the mill to start with. They are laid off by the lead man of the driving box gang, and when one box is completed the

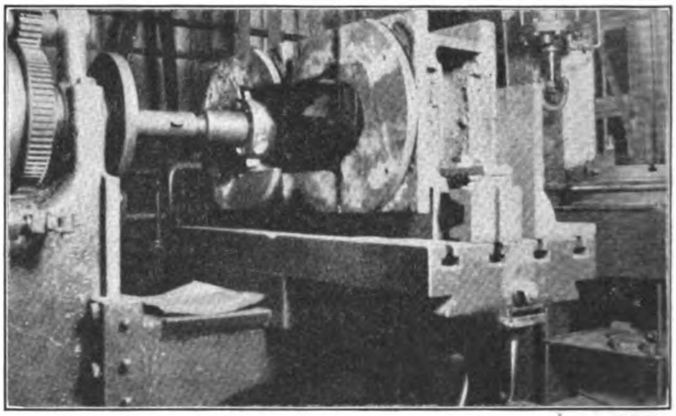


Fig. 2—Method of boring driving boxes in a horizontal boring machine

*One of the papers presented in the driving box competition which closed April 1, 1924.

boring mill man shifts the table over to the other and begins boring. While the heavy roughing cut is being taken, he hoists up another box and fastens it to the table. This keeps the tool almost continually busy.

Manner in which the boxes are bored

The front, intermediate, and back boxes are bored 1/32-in. larger than the journal while the main boxes are bored to a snug running fit. The front, intermediate and back boxes have a recess cut in the crown of the brass, as shown in Fig. 3, and are also undercut 1/32-in. deep, and about 1 in. back from the edge of the fillet, or shoulder at point *A*. Grease or journal compound grooves are cut 3/16-in. deep, by 3/16-in. wide, extending from the undercut edge of the brass to the recess

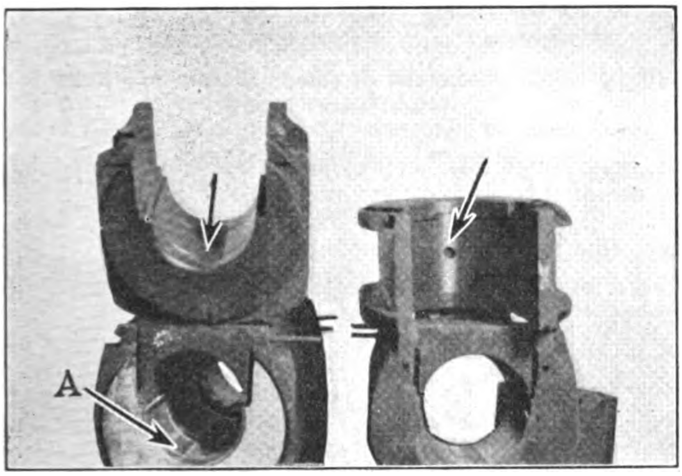


Fig. 3—Arrows indicate the location of the recesses in the driving box brass—Point A shows the location of the undercut

in the crown of the brass. This is to give the journal compound a good starting place to feed through, or circulate around the journal, as new brasses must have plenty of lubricant to start with in order to obtain the proper amount of mileage from the locomotive before it has to have its brasses recrowned or renewed. It is safe to say that 50 per cent of the success with journals regarding pounds and mileage, is due to the quality of the brass that is used in the box. It is very essential that driving box brasses should be cast of the very best material.

The machining of the main driving box requires just a little different operation at point *A*, Fig. 3. The brass is undercut 1/32-in. deep, and only ⅜ in. back of the fillet, instead of 1 in., as in the other boxes. The purpose for this difference is to have a snug job on the main boxes, as they pound soon enough. On the switch engines, the grease grooves are cut entirely around the bore of the brass because they back up as much as they go ahead. The Franklin No. 4 lubricator is used on switch engines with ⅜-in. perforations in the grease cellar as this type of locomotive never moves fast enough to warm the journal compound so that it will feed freely. On freight and passenger locomotives the Franklin No. 4 lubricator is used also, but it has 3/16-in. perforated cellars, instead of the ⅜-in. size.

Cutting the compound grooves on freight and passenger locomotives differs somewhat from the practice for switch engines. They are cut 3/16-in. wide, but only one groove is cut in the brass on the shoe side, and two on the wedge side. The reason for this is that road engines move ahead much more than they move backwards.

Fig. 4 shows the method employed for machining the circle on the rough box preparatory to fitting the brass. Four of the average size boxes or two of the heavy Mountain and Santa Fe type locomotive boxes are set up at one time on the table of a Morton draw cut shaper.

The hub liner problem looms up at this point of the article for its criticism. Many schemes have been tried and found wanting. Even Henry Ford is experimenting along this line, by testing hub liners of steel, case-hardened and ground, on Detroit, Toledo & Ironton locomotives. Of course, every mechanical supervisor has tried some kind of a hub liner, and when it is all summed up, they all get about the same results. The hub liners used at this point are made from steel boiler plate, electrically welded to the driving wheel center or hub. This method is inexpensive, and requires very little machine work, as the liners are laid off on sheet metal in circles to within ¼ in. of size, cut out with the acetylene torch, turned on the outside diameter and bored, separated in only one place, heated on the side opposite to the cut, applied to the journal, and then welded to the wheel center.

Other factors to consider

Good machine tools are among the most important factors in obtaining efficiency and production in a locomotive shop. The foreman comes in at this point for a little criticism. He has to be a "live wire," a good leader and instructor, and also must have the confidence of his men, to get the best results. The only way to gain the

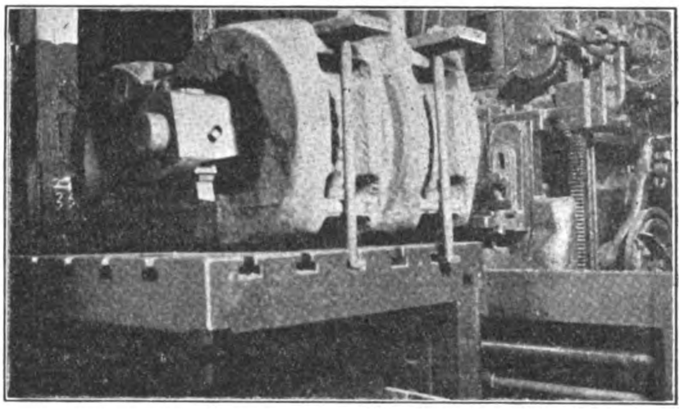


Fig. 4—Method of machining circles on the rough box preparatory to fitting the brass

confidence of his men is to show that he is a first-class mechanic and up-to-date in his methods.

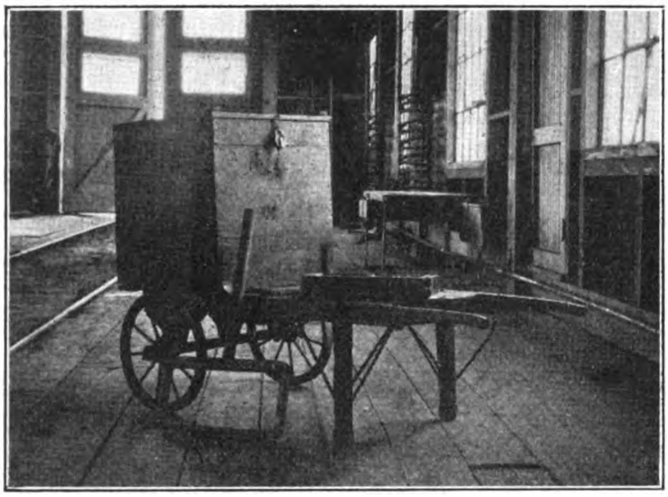
The tool room should not be neglected, as it makes for efficiency and production when it furnishes the proper tools and fixtures to work with. When you have machine tools that cannot produce, change them so they will give the desired results. When a machine tool will drive all the high speed tool bits will stand, then it is certain that the machine is giving production.

The cars in use by the British railways have always been very diminutive from an American standpoint, and now that the 120-ton coal car is coming into use on this continent, so at least one British road is adopting larger cars for its coal traffic. The road is the Great Western, and the new cars which it has placed in service are of 20 long tons' capacity, replacing cars of 8, 10 and 12 long tons. Apparently the chief obstacle in the way of adopting larger cars in England, aside from the severe limitations of clearance, is the habit and equipment of the shippers. Shippers equipped to handle 12-ton cars may find changes in methods and perhaps additional capital expenditures necessary in order to utilize the larger cars. Therefore, in order to offer some inducement to shippers, the railway is offering a 5 per cent rebate to all shippers using the larger cars loaded to capacity.

Portable tool box for valve motion mechanics

THERE can be found in railroad shops many types of portable tool boxes but the one shown in the illustration and used at the Billerica shops of the Boston & Maine has its own unique advantages. This tool box is particularly designed to meet the requirements of the mechanic who sets and squares up valve motion.

For this specialized job the mechanic must have a certain set of tools among which are such items as, trams, scribers, dividers, etc., which must be properly taken care of. This he can readily do by placing them under lock and key in the box shown. At the end of his day's work



Combination portable tool box, material wagon and ladder for locomotive mechanics

he can leave the box set wherever he may be in the shop and come back in the morning and find it there with the tools intact.

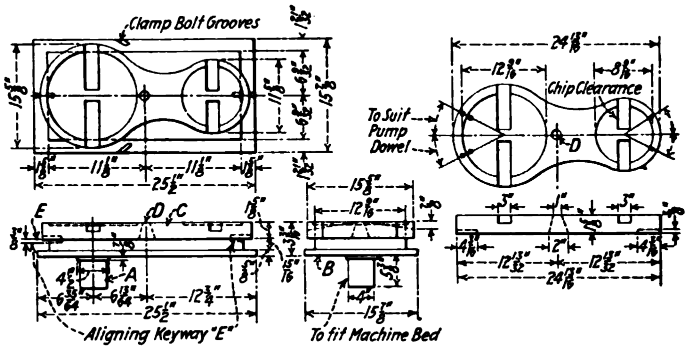
It will be noticed that the box covers only half of the top of the wheel-barrow. The remaining part is used to haul valve motion parts to the locomotive and is also convenient for the machinist to stand on so that he can readily reach the highest point of the valve motion.

Boring jig for air pump cylinders

STEAM and air cylinders can be bored complete in 10 min. on a Bullard vertical turret lathe or boring mill by using the jig here illustrated. The jig is placed on the bed of the boring mill with the lug *A* fitted into the center hole of the bed. It is then secured to the bed by bolts which enter the bolt grooves on the bottom plate *B* of the jig shown in the sketch. This completes all the work necessary to align the air pump cylinders to the boring spindle or tool. Both the top and bottom plates have dowel holes drilled at different radii so as to fit the dowels on different sized pumps.

The pump is placed on the jig, either end up, with the dowel pins on the cylinders inserted in the dowel holes. This places the center line of one cylinder equidistant from the boring bar and it is then ready for boring.

After one cylinder has been bored, the keys *E* are pulled out, which allows the pump and top plate *C* to turn on the pin *D*, bringing the other cylinder into position for boring. The keys *E* are then replaced in the keyways and the job is completed. Pump cylinders have been refinished on this jig, placed on an old boring mill, quicker than on machines built especially to do the work. Grinding a badly worn pump cylinder usually takes from one to three hours, but it has been found that much time



Jig for holding steam and air pump cylinders on a Bullard vertical turret lathe

can be saved if the pump cylinders are rough bored by the use of this jig and then ground.

This jig was designed by W. L. Lauer, general foreman, Illinois Central, Memphis, Tenn.

Securing small hubs or levers to shafts

CERTAIN minor locomotive parts such as bell yoke bearing shafts, cylinder cock levers and stoker mechanisms, in common with numerous machine parts not from locomotives, are positioned and secured by a taper pin or rivet as shown in Fig. 1 of the sketch. This method has the advantage of being simple and requiring a minimum of time in completing the assembly of the parts, but often causes trouble owing to the tendency of

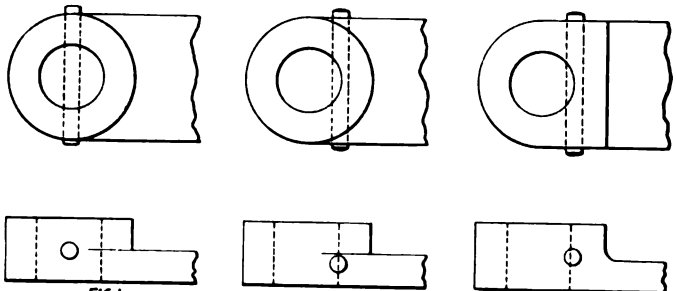


FIG. 1 FIG. 2 FIG. 3

The additional metal allowed by the arrangement shown in the last two figures tends to eliminate breakage

the pin or rivet to shear or occasionally the shaft to break on account of its reduced cross section.

The same size pin applied through the side of the shaft as shown in Fig. 2 presents a greater cross section to either a rotating or end movement of the shaft. Another advantage is that the work cannot be assembled with the shaft a half turn from its proper position as sometimes happens when the pin is located as in Fig. 1. As the parts thus assembled are not usually intended to be interchangeable with similar parts, no disadvantage occurs due to the changed position of the pin.

If the hub is forged or cast as in Fig. 3 the additional metal serves to reinforce the pin bearing and lessens the chances of hub breakage which exists in Fig. 1.

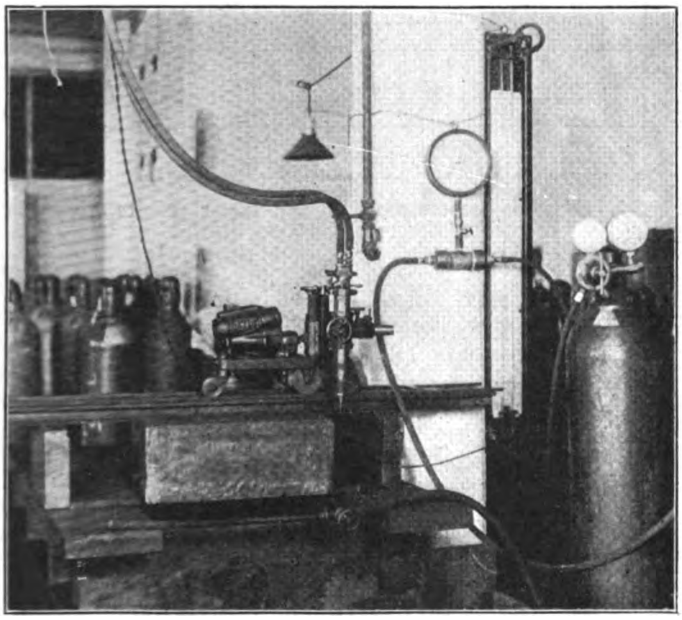
Economies effected by the use of high purity oxygen*

Consumption of the gas and the cutting time substantially reduced—Drag of cut improved

By John J. Crowe † and George L. Walker ‡

UNTIL a comparatively recent date, all oxygen was produced by chemical or electro-chemical means, and some of the older users of oxyacetylene torches will tell you that the oxygen produced for welding and cutting was very expensive and that it was about as impure as it was expensive when judged by our present standards. Today most of the oxygen used in oxy-acetylene welding and cutting is manufactured by the liquid air process.

The atmospheric air is liquified by compressing and cooling, and the oxygen is obtained by what amounts to a distillation process. The boiling temperature of oxygen at atmospheric pressure being —296.5 deg. F., whereas the boiling point of nitrogen is approximately 24 deg. F. lower or —320.8 deg. F.



Radiograph controlled cutting torch

The discovery of the principle of the oxyacetylene torch was first announced by the famous French physicist Henri LeChatelier in 1895 in a paper read before the Academie de Sciences, on the temperatures of flames. He stated at that time that the temperature of the oxyacetylene flame was 1,000 deg. C. higher than the oxyhydrogen flame, and we know today that the temperature approximately 3,480 deg. C. (6,300 deg. F.) exceeds that of any other know flame and closely approaches the temperature of the carbon arc. Practice application was made of the principle of the oxyacetylene flame by Fouché and Picard when they developed the first oxyacetylene torch in 1901.

The first torches were for welding, but it was not long before application was made of the principle of iron and steel combustion in an atmosphere rich in oxygen when raised to their ignition temperatures.

Oxygen purity

Until quite recently oxygen users were contented with oxygen of 97 to 98.5 per cent purity, but today, at least in the United States, such is not the case. By improving the apparatus and operation of liquid air plants it has been found possible to manufacture, commercially, oxygen of much higher purity. By stages the purity of oxygen has been increased until now it is possible to obtain, continuously by that method, oxygen with a guaranteed purity of 99.5 per cent, plus or minus a tolerance of 0.1 per cent.

The question naturally arises, what benefits are to be derived from small increments in purity as we approach the ultimate limit of 100 per cent oxygen. To answer this question the Air Reduction Sales Company has carried out two series of experiments extending over a period of several years, and it is the results of these experiments which are presented in this paper.

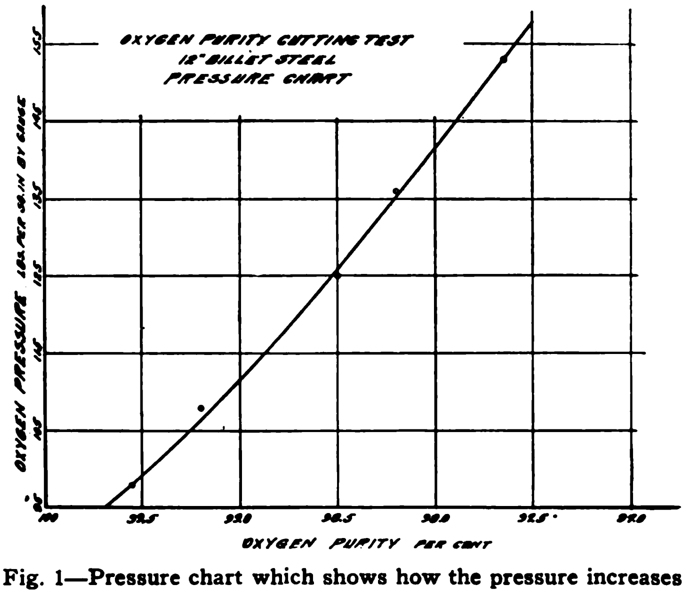


Fig. 1—Pressure chart which shows how the pressure increases as the purity of the oxygen decreases

Method of making tests

The experiments were made on steel plates and rolled steel billets, ranging in thickness from 3/8 in. to 12 in. To eliminate the human element or personal equation as far as possible, all the cutting done in the first series was done with a hand torch mounted on a radiograph geared

*Abstract of a paper presented at the February 16 meeting of the American Welding Society, New York City. Copyright, 1925, by the Air Reduction Sales Company, New York.

†Engineer in charge of the apparatus research and development department, Air Reduction Sales Company.

‡Associate engineer of the apparatus research and development department, Air Reduction Sales Company.

to give variable speeds from a few inches per minute up to 60 in. or more per min., and in the second test series the cutting was done with a machine torch mounted in the same manner.

The speed of the radiograph was checked with a stop watch. The pressure, where practicable, were measured with mercury manometers, and the higher pressures were measured with standard test gages, frequently calibrated and tested on a dead weight gage tester. The gas (oxygen and acetylene) consumptions were obtained by weighing the cylinders before and after using, on scales accurate to ¼ ounce, and these weights were checked up making up the loss in weight with shot and then weighing the shot on a separate balance. All the material was cooled to approximately the same temperature before cutting, and the experiments were carried out under laboratory conditions in which every possible variable was controlled as closely as possible.

Table I—Oxygen consumption of various purities required to cut metals of various thicknesses, using 100 cu. ft. of 99.5 per cent oxygen as a basis of comparison.

Thickness of metal, in.	Series No.	Oxygen purity 99.5 per cent	99.0 per cent	98.5 per cent	98.0 per cent	97.5 per cent
3/8	1	100.0	114.1	125.5	.....	.....
1/2	1	100.0	111.1	121.5	.....	.....
3/4	1	100.0	116.0	140.0	.....	.....
1	1	100.0	115.4	135.0	.....	.....
2 1/8	1	100.0	108.0	123.4	.....	.....
2 3/8	2	100.0	112.1	127.5	148.8	173.9
4 3/8	1	100.0	113.3	141.5	.....	.....
6	1	100.0	108.8	133.6	.....	.....
6	2	100.0	114.8	131.7	150.1	169.3
12	1	100.0	108.4	119.5	.....	.....
12	2	100.0	108.9	122.0	139.0	161.0
Average consumption		100.0	111.9	129.2	145.9	168.1
Difference for each ½ per cent decrease in oxygen purity.....			11.9	17.3	16.7	21.5

The laboratory was furnished with an ample supply of oxygen varying in purity from 98.5 per cent to 99.5 per cent by steps of approximately ¼ per cent for the first series and from 97.5 per cent to 99.5 per cent by ½ per cent steps for the second series. The actual purities were determined at the time of manufacture, and were carefully checked in the laboratory.

Previous experiments in which oxygen of various purities manufactured by the electrolytic process compared with a pressure that would make the cut without difficulty, and then to reduce the pressure by stages until the minimum pressure was found that would just make the cut.

Preliminary experiments were also made to determine the most economical size of tip and the speeds to use in making the final cuts. The curve shown is concave upwards but only slightly so, and this is typical of all curves plotted in this manner.

Taking Fig. 1 as an example it will be noted that the

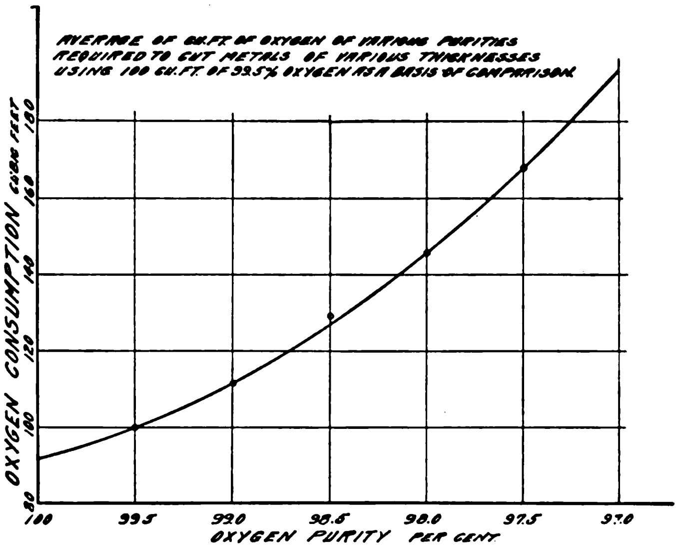


Fig. 2—Graphic presentation of the mean results given in Table I

pressure required to cut a billet 12 in. thick using oxygen of 99.5 per cent purity was 99 lb. per sq. in., whereas it required a pressure of 112 lb. when the oxygen purity was reduced 0.5 per cent and if the purity was dropped to 98.0 per cent the pressure required was increased to 142 lb.

As the cutting tip was the same for all cuts on the same thickness of metal the oxygen consumption for the same amount of cutting increases with the pressure required to make the cut.

Table II—Actual time required to make cuts of given lengths of metals of various thicknesses using oxygen of various purities and time expressed in percentages using time required with oxygen of 99.5 per cent purity as a standard.

Thickness of metal, in.	99.50 per cent: Time to make cut, min.	sec.	Per cent	99.25 per cent: Time to make cut, min.	sec.	Per cent	99.00 per cent: Time to make cut, min.	sec.	Per cent	98.75 per cent: Time to make cut, min.	sec.	Per cent	98.50 per cent: Time to make cut, min.	sec.	Per cent
3/8	74	18	100	79	51	107.3	84	45	114.0	91	30	123.1	93	24	125.5
1/2	42	15	100	43	13	102.3	46	54	111.0	48	42	115.2	51	15	121.3
3/4	35	45	100	38	3	106.4	41	27	115.9	48	48	122.5	50	5	140.1
1	35	20	100	37	18	105.6	40	45	115.3	43	0	121.7	47	39	135.0
2 1/8	26	7	100	27	4	103.7	28	12	105.0	29	40	113.7	32	14	123.5
4 3/8	14	29	100	15	25	106.5	16	25	113.4	18	32	128.0	20	27	141.3
Mean			100			105.3			112.9			120.7			131.0
Difference for ¼ per cent in oxygen purity						5.3 per cent			7.6 per cent			7.8 per cent			10.3 per cent
Difference for ½ per cent in oxygen purity						12.9 per cent						18.1 per cent			

with oxygen of the same purities manufactured by the liquid air process had shown no measurable difference.

Results of the tests

In the typical graph shown in Fig. 1 the minimum pressures required to cut a 12-in. billet have been plotted against the purity of the oxygen used. To determine these pressures a large number of preliminary cuts were made on each thickness of metal with oxygen of each purity. The method of procedure followed was to start

In order that the data obtained may be more easily compared they have been tabulated in Table I after reducing to a common basis, that is, the number of cubic feet of oxygen of the various purities required to cut metals of the various thicknesses, using 100 cu. ft. of 99.5 per cent oxygen as a standard of comparison. The mean of the results given in the table is shown graphically in Fig. 2.

It will be noted that 11.9 per cent more oxygen of 99.0 per cent purity is required to do the same amount of cutting as was done with oxygen of 99.5 per cent purity, and

when the oxygen purity was dropped from 99.5 per cent to 98.5 per cent the increase in consumption was 29.2 per cent. In other words, it required 129.2 cu. ft. of 98.5 per cent oxygen to make the same length of cut as was made with 100 cu. ft. of oxygen having a purity of 99.5 per cent.

The preceding data have shown how the oxygen consumption increases with a decrease in oxygen purity without reference to time. The results of time studies made in the first series of experiments on sizes up to 4⅜ in. thick are given in Table II. Owing to the large amount of material involved, these experiments were not extended to cover the larger sizes, all the cutting on the 6-in. and 12-in.

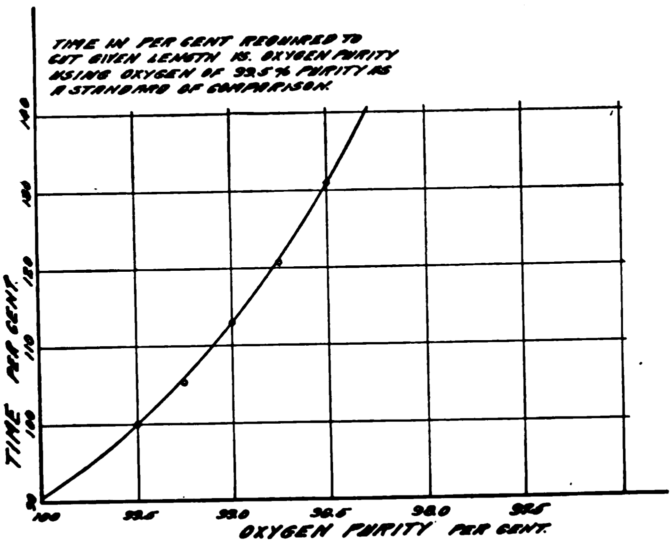


Fig. 3—Graphic presentation of the data given in Table II

billets being made at constant speed. The actual time to make the various cuts is shown in Table II and in order to compare the results they have all been reduced to a common basis and expressed in percentages using the time obtained with 99.5 per cent purity oxygen as a standard of comparison.

The loss in time expressed in percentages very closely approximates the waste in oxygen as the purity decreases, and the two go together, that is, as the oxygen purity decreases the time required to make a given cut goes up as shown in Table II, and the consumption of oxygen in making the cut goes up at the same time as shown in Table I. The average of the results expressed in percentages as shown in Table II is shown graphically in Fig. 3.

How pure oxygen effects drag

The characteristic drags obtained on the 12-in. billets with oxygen of four different purities are given in Fig. 4. For some work, such as straight line cutting, the amount of drag may not be of serious consequence but in the machine cutting of intricate shapes the drag must be maintained at a minimum as otherwise the underside of the shape cut will not register with the top side.

To decrease the drag to correspond with that obtained with the high purity oxygen (99.5 per cent) it would be necessary to increase greatly the pressures and it follows that the consumptions for the lower purities would be much greater than those shown in the curves and tables.

It was not the purpose of this investigation to enter into any considerable number of practical applications in cutting with high purity oxygen and the results obtained, but anyone interested can easily demonstrate the superior cutting properties of high purity oxygen by making simple and practical tests, if they will obtain oxygen of, say, 99.5 per cent purity and oxygen of 99.0 per cent purity or less and make cuts in the same steel plate or forging with both oxygens.

As a field check on the investigation made in the laboratory, a large number of oxygen cylinders analyzing 99.5 per cent and an equal number of oxygen cylinders analyzing 99.0 per cent were used for wrecking steel cars, and a careful study was made of the results obtained with the two oxygen purities. Ten cars were scrapped with each purity of oxygen, and to eliminate as far as possible the personal equation the operators were frequently changed from one oxygen purity to the other, and at no time were the operators informed as to the purity of the oxygen supplied them. Weather conditions were bad, the temperatures ranging from —30 deg. F. to —21 deg. F. and the cars were covered with snow. Working under these conditions and with operators some of whom had only a limited experience in oxyacetylene cutting, a saving of 10 per cent was shown in oxygen consumption and 11.2 per cent saving in time, both in favor of the oxygen having a purity of 99.5 per cent.

The following conclusions may now be arrived at.

First.—That small increases in oxygen purity greatly increase the efficiency of cutting operations, both as measured by oxygen consumption and by time required to complete a given amount of cutting.

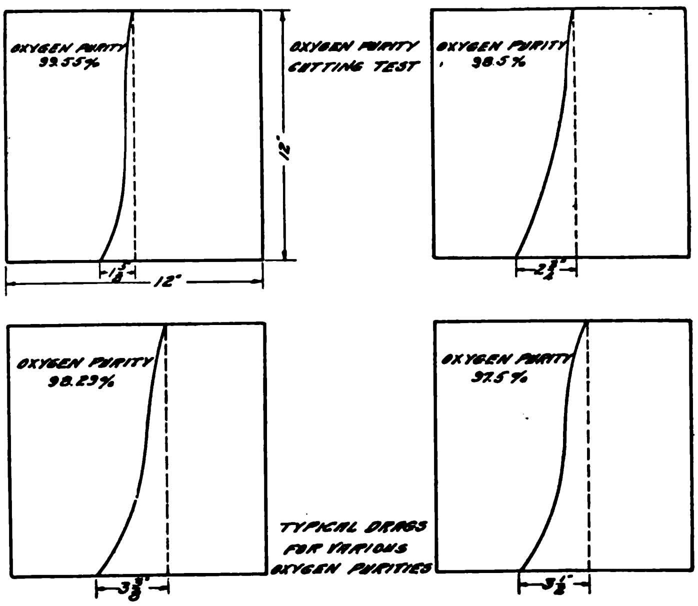


Fig. 4—Characteristic drags obtained on 12-in. billets with oxygen of four different purities

Second.—That the difference of effect of small increases in oxygen purity decreases as 100 per cent purity is approached, but the effect is of considerable magnitude for the interval of 99.0 per cent to 99.5 per cent oxygen purity showing a saving of approximately 12 per cent for oxygen consumption and an equivalent saving in time.

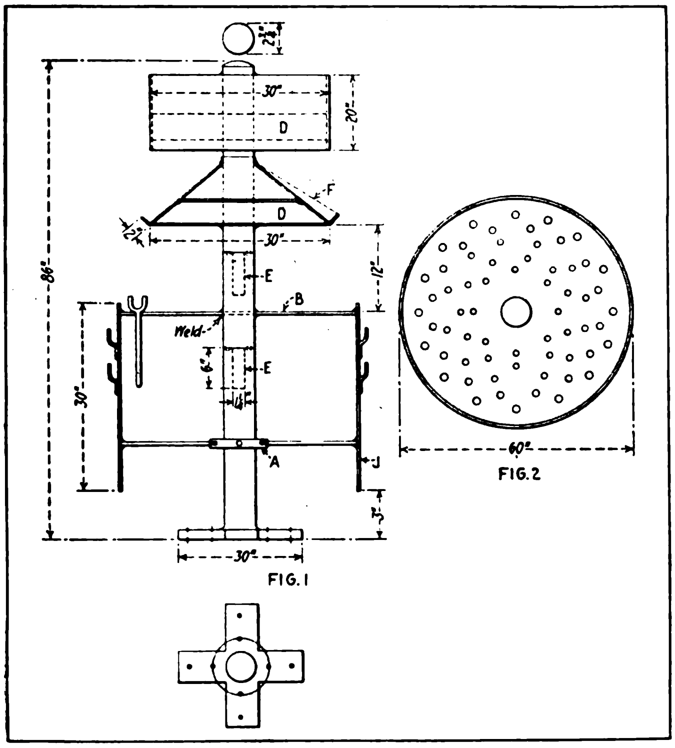
Third.—That decreases in consumption and time with small increases in oxygen purity found by the laboratory have been substantiated by practical applications made with oxygen of 99.5 per cent and 99.0 per cent purity.

The shops of the Pennsylvania Railroad at Sunbury, Pa., according to report, are soon to be closed. These shops, employing about 500 men, have been in operation since 1876. Reports say that the skilled workmen will be employed by the road at other places. The Sunbury shops are not equipped for repairing modern large locomotives.

A handy tool rack for the boiler shop

By Joseph Smith

PROVIDING the proper means for storing and distributing tools is quite as essential as having sufficient tools. Fig. 1 shows the elevation of a tool rack with a central shaft 2¾ in. in diameter in three sections, turned down and bored out as shown at *E* and



A boiler shop tool rack with two separately revolving containers

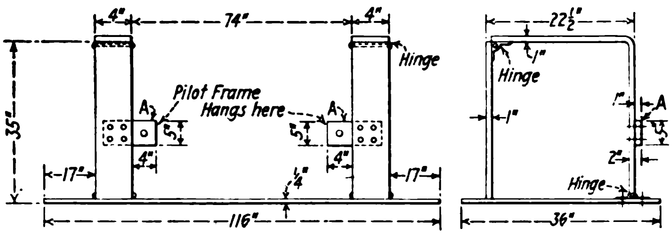
recessed as shown for ½-in. ball thrust bearings. The circular shell *J* is 60 in. in diameter and is made of ⅛-in. steel plate. The head, *B*, is constructed of ¼-in. steel plate welded to the shell *J* just a little below the top edge. The head, as shown in Fig. 2, has holes burned in at random to accommodate single ended wrenches, socket wrenches and various other tools. The brackets on the side of the shell are for double-ended box wrenches and similar tools. *A* is a wrought iron collar, bored for an easy fit around the shaft, and drilled and tapped out for four ⅞-in. rods. These rods are adjusted to the inside diameter of the shell and welded as shown, to support the bottom of the shell.

Front and end views of two shelves, made of ⅛-in. steel plate, are shown at the top of the drawing. These shelves are welded, as shown at *D*, and are used for storing small tools. They are made in one piece with a hole cut at the top to slip down over the shaft. The shelves are constructed with a 2-in. flange along the bottom edge to prevent the tools from sliding off. A taper flange is also welded on at each end, as shown by the dotted line *F*. These shelves may be used for staybolt taps, spindle taps and reamers.

The base is fastened to the floor by wood screws and is made of 4-in. by 1-in. flat iron. One piece is offset to fit over the other and both pieces are bored to fit the bottom of the shaft and welded. In assembling the shaft, a liberal supply of lubricant should be applied in the bore and at the ball bearings. An attendant can reach any tool by simply turning the rack.

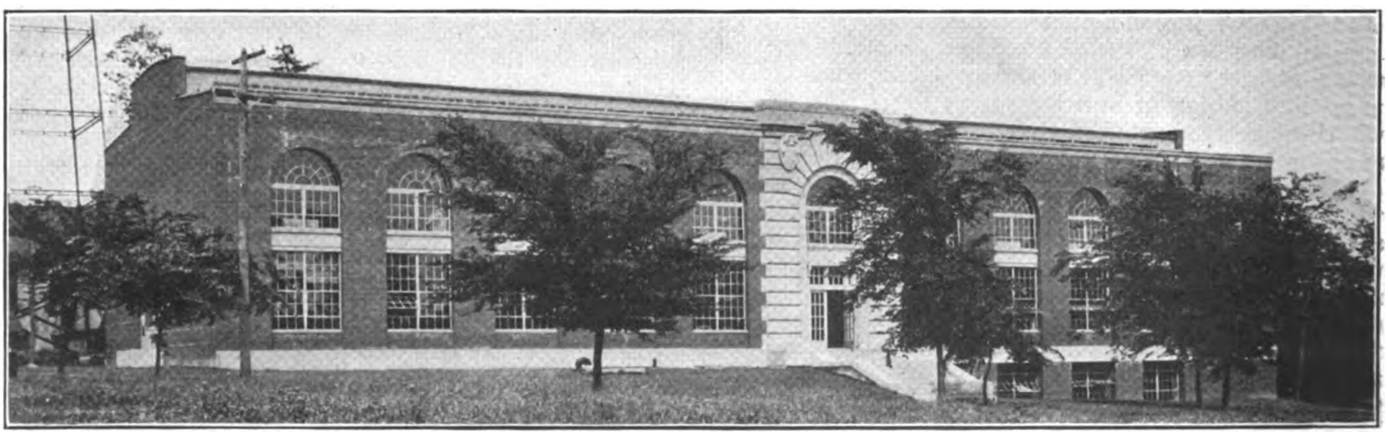
Jig for holding steel pilot frames when riveting

THE method of riveting together steel pilots as they rest on the floor always causes more or less trouble and inconvenience owing to the difficulty of placing them in different positions in order to rivet the various frame members. The difficulty was overcome by designing a jig, at the Grand Rapids, Mich., shops of the Pere Marquette, which swings on hinges enabling the workmen to place it in any position he may desire.

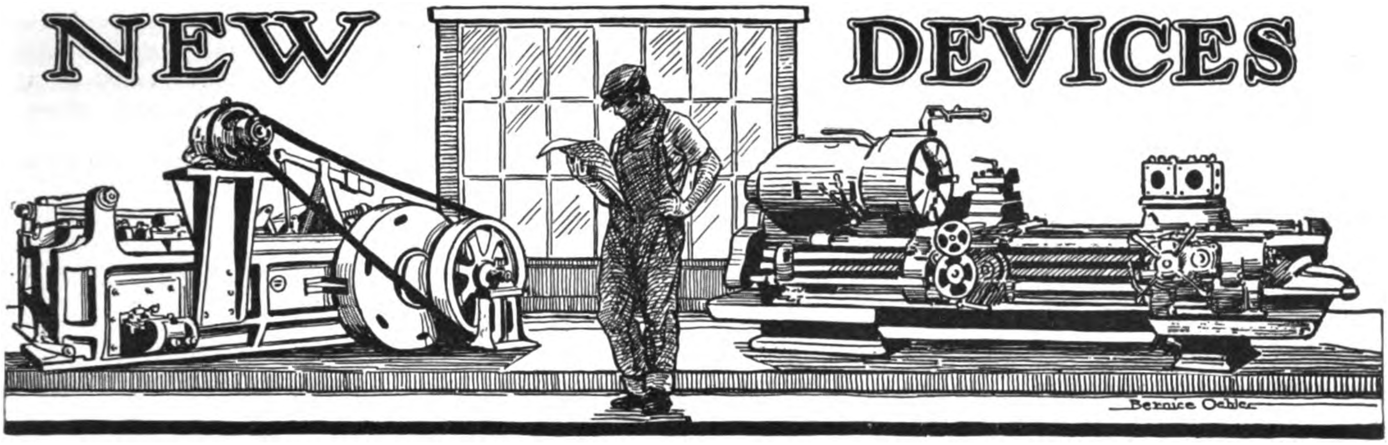


A pilot frame jig which swings on hinges

Referring to the illustration, the pilot frame is bolted to the lugs *A* thus holding it in the proper position for riveting. The hinges of the jig allow the pilot to be swung to all workable positions with very little effort, and a considerable saving of time.

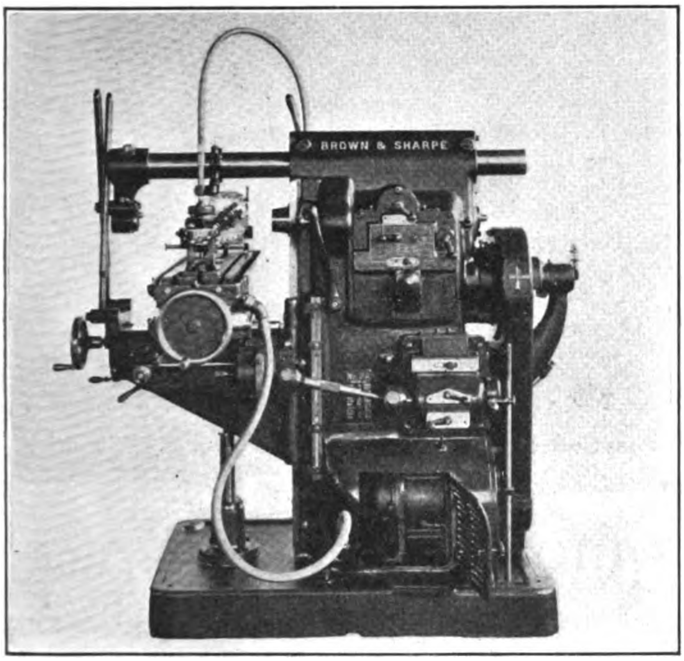


The mechanical engineering laboratory of The Pennsylvania State College



Milling machine with the motor in the base

A MILLING machine designed so that the motor is incorporated in the base has been placed on the market by the Brown & Sharpe Manufacturing Company, Providence, R. I. These machines, when equipped with a motor, are entirely self-contained, the motor being enclosed in an oil-tight compartment in the base.



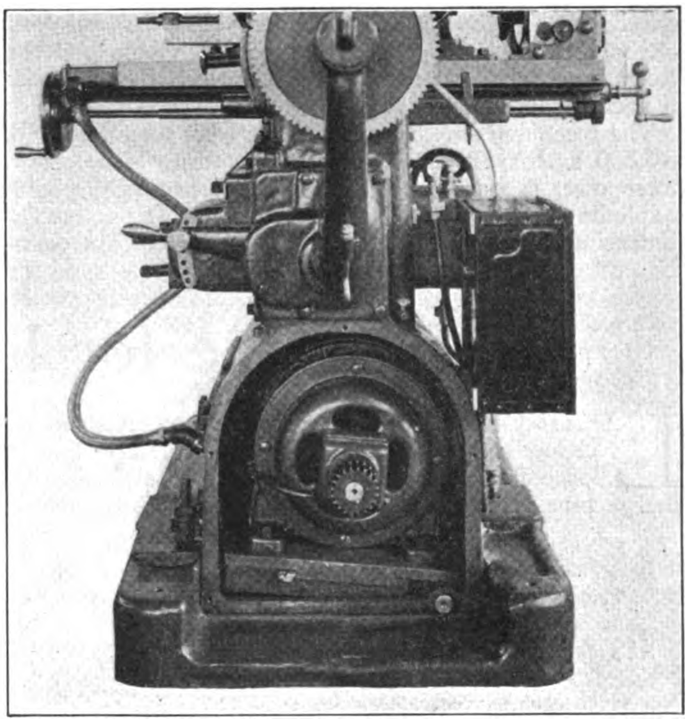
View of the right side showing the oiling arrangement for the motor bearings

The new design does not differ materially from the column and knee type except to include the construction necessary for this style of drive. The important change comprises a redesign of the lower part of the column to provide for the motor compartment which is cast with a solid top as a part of the column. Complete protection is furnished the motor from oil, cutting lubricant, chips and dirt. A tank for the cutting lubricant is located in the base, extending around the foot of the elevating screw. Strainers set in the top of the base provide for the prompt return of all oil to the reservoir.

Ample provisions have been made to insure a sufficient circulation of air by three ventilators located on the sides and rear of the compartment. They serve a two-fold purpose in that they also permit ready access to the motor for purposes of lubrication, repairs, adjustment and cleaning.

Oil wells fastened to the frame of the motor and readily accessible through the door on the right of the machine, are connected by tubes to the motor bearings. This permits quick and positive lubrication of these parts.

In order to facilitate installing and removing the motor and to provide for adjustment of the driving chain, a separate adjustable base is provided on which the motor is mounted. This base is hinged on the right side and has an angular adjustment regulated by means of the bolt on the left of the column outside the compartment. The bed of the motor is tongued and slides into a groove in the hinged base. When in position, the motor is held firmly in place by a gib inserted in the motor ways. The



Rear view with chains and guards removed, showing interior of the motor compartment

driven and driving sprockets as well as the driving chain are fully enclosed by a cast iron guard.

A distinctive feature of the machines is the ease with which the friction driving clutch can be adjusted. This clutch is mounted within the driving pulley or sprocket, on the main drive shaft. By removing the small plate on the side of the pulley, through an opening in the chain guard, the clutch can be readily adjusted without any further dismantling of the machine.

All parts of the machine are conveniently located for purposes of adjustment and operation. Complete access to the motor compartment is obtained by removing the chain guard, the chain and rear wall of the compartment.

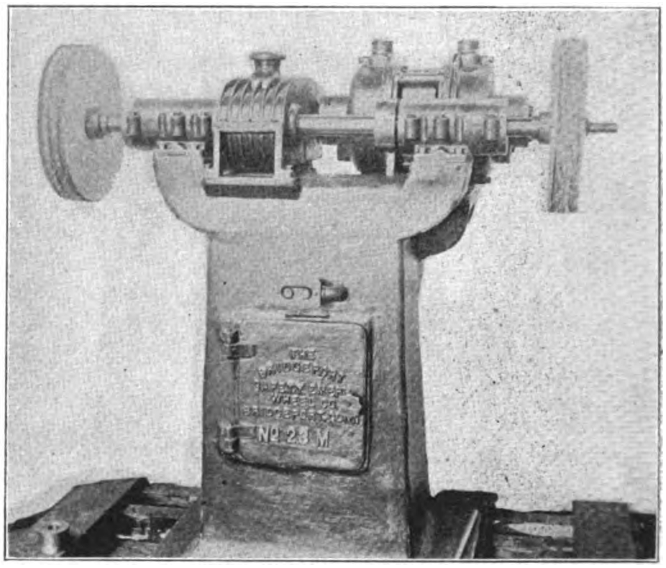
When used as a belt-driven machine the motor compartment is available for storage of tools and parts. The change from belt to motor drive can be easily and quickly accomplished. These machines are made in two styles of three sizes each; the Nos. 1A, 2A and 3A universal and the Nos. 1B, 2B and 3B plain milling machines.

Buffing lathe with chain drive

CONSIDERABLE difficulty has been experienced in the past by the Bridgeport Safety Emery Wheel Company, Bridgeport, Conn., in obtaining a suitable drive which would give the desired buffing speed when using 60-cycle, alternating current. In a newly designed motor-driven buffing lathe this difficulty is said to have been overcome by mounting the motor on the back of the machine and connecting it with a chain drive to the grinding wheel spindle. By using appropriate sizes of chain sprockets the buffing spindle can be brought within close range of the desired speed.

The machine pedestal is cast with a bracket on the back on which the driving motor is mounted. This brings the center of the motor shaft horizontally back of the buffing spindle and the two are connected with the silent chain drive. This chain runs in an oil-tight case with an oil bath in the bottom, which insures continual and positive lubrication. Both the motor spindle and the buffing spindle run in ball bearings. The buffing spindle has four sets of bearings, one at each end of each box, and the boxes have large oil reservoirs into which the balls dip at each revolution.

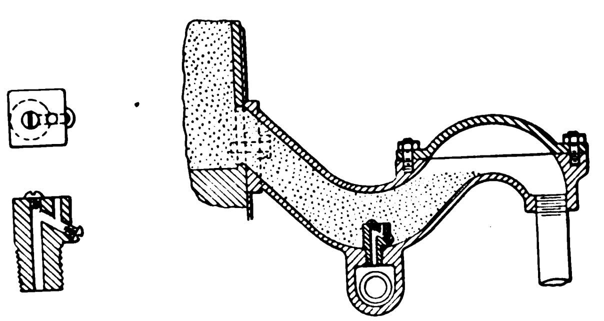
The machine is built in three sizes, each furnished with a 3,500 r.p.m., alternating current motor, which have a horsepower capacity of 2, 5 and 7½, respectively, giving a spindle speed of 2,400 and 2,500 r.p.m. The following dimensions are for the larger type of machine. The diameter of the spindle in the bearing is 2 in., length of the bearing 10½ in.; diameter of spindle where the wheel fits, 1½ in.; height from floor to the center of the spindle, 33 in.; net weight, 1,350 lb.



Motor-driven buffing lathe provided with a chain drive

Air nozzle for locomotive sanders

LOCOMOTIVE sanders of ordinary construction include a substantially straight air nozzle that is located in the lower portion of a pocket in the discharge pipe leading from the sand dome. It frequently happens that the duct in the air nozzle and the air chamber immediately beneath it become filled with sand. As a result of vibration, the sand becomes packed to such a degree as to prevent the compressed air, when turned on, from blowing through the sand discharge pipe, thus failing to serve its purpose.



Air nozzle designed to prevent the sand from packing in locomotive sanders

The air nozzle, shown in the illustration, has been designed in a manner which apparently overcomes this trouble. The air nozzle is seated in the bottom of the U-shaped portion of the trap immediately above the compressed air chamber and projects upwards into the passageway of the trap. The nozzle includes a rectangular metal body provided with an externally threaded shank that is screwed into the bottom of the trap. Formed through the body of the nozzle is an air duct the upper end of which is closed by means of a screw. There is formed in the upper portion of the body and immediately to one side of and parallel with the main air duct, a short duct extending a short distance down the body. These two air ducts are connected by a duct which is inclined at an angle of 45 deg. with respect to the horizontal. The lower end of this air passage is also closed with a screw plug. The three air ducts form a Z-shaped air passage, the inclined portion of which forms a trap between the

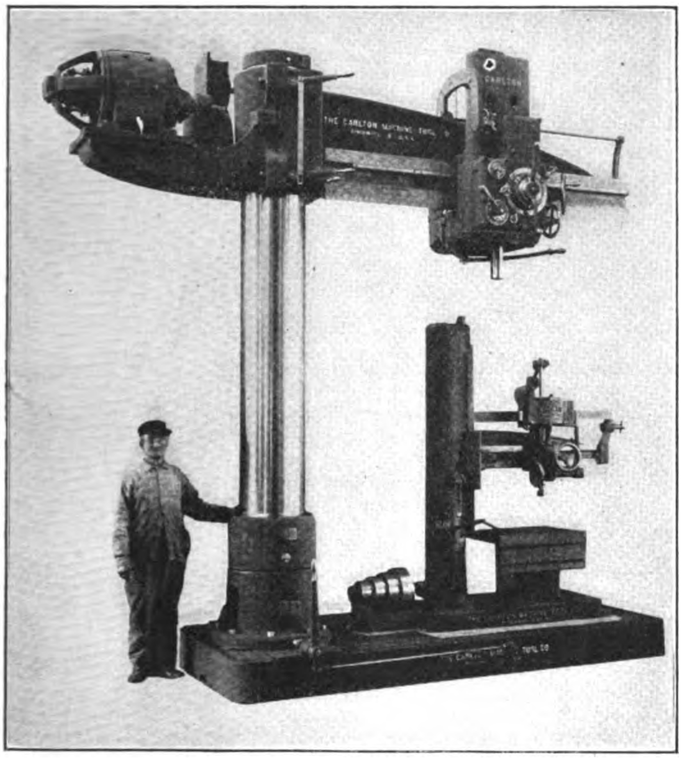
vertical portions that will receive and retain a relatively small amount of sand and consequently prevents the passage of any large amount of sand through the nozzle into the main air chamber. In this manner the sanders are prevented from becoming ineffective by the packing of sand within the air nozzles as it is only necessary to expel a relatively small amount of sand from the two smaller air ducts.

This device has been patented by John W. Simpson, Santa Barbara, Cal.

Ball bearing heavy duty radial drill

A RADIAL drill equipped throughout with ball bearings, constructed on the unit principle, having a concentrated and convenient control and a low-hung drive of the spindle, has been developed by the Carlton Machine Tool Company, Cincinnati, Ohio. Particular attention has been paid to lubricating the machine to increase production by reducing friction, wear, power losses, shutdowns and renewals.

The speed box is composed of several sub units. The driven shaft is provided with four keys running almost its entire length. The six gears which form the cone are made of alloy steel with four keyways multiple broached to fit on the shaft. The large gear on the end is made of cast iron which carries a pawl to drive the ratchet mounted on the shaft so that when the train of gears is disconnected, the pawl drops in the ratchet and keeps the gears in constant motion. The upper shaft, which carries the sliding tumbler gears, is also made from the solid bar. The ratchet teeth on the tumbler engage with a small segment on the front cover and are used only for engaging and disengaging the train of gears. The speed box is entirely closed with long levers extending to the front of the column for the convenience of the operator. The speed box contains a sight oil gage. There are 24 speeds in geometrical progression covering a range from 18½ to 800 r.p.m. when the speed box pulley is revolving at 500 r.p.m. A range of 24 to 1,000 r.p.m. may be obtained if desired by revolving the speed box pulley at 600 r.p.m. These high speeds are made possible by the fact that every bearing, shaft or sleeve is supported by ball bearings. There are 12 feeds mounted in the head, covering a range of .004 to .060 in. per revolution of the spindle.



Carlton 7-ft. heavy duty radial drill with the column lengthened to take 8 ft. 3 3/16 in. under the spindle

The stump knee has been designed as a complete unit in a housing. The horizontal shaft with bevel gears is mounted with ball bearings at each end. The bevel gear which carries the vertical shaft is mounted on a steel sleeve which is supported on each end with ball bearings. A sight oil gage indicates the amount of oil that these gears should run in.

The cap contains only three gears which are mounted on steel sleeves and supported on each end with ball bearings. These gears transmit the power from the center shaft to the outside vertical shaft. This unit runs in an oil bath which is controlled by a sight gage.

The arm knee elevator fits on the back of the arm and carries the bevel gears which transmit the power from the vertical to the horizontal shaft. These gears are also mounted in steel sleeves supported on each end with ball bearings. The power for raising and lowering the arm is taken from this unit. The tumbler gears are made up in a unit and mounted in the arm knee elevator. These gears tumble in mesh with the gear on the vertical shaft which is constantly in motion for raising and lowering the arm. This unit also runs in oil and has a sight oil level gage.

The head on the arm has two holes bored parallel, one for the weight and one for the spindle. Both the spindle sleeve and the counter-weight have generated teeth their full length and both balance on a pinion gear which is mounted in ball bearings. The head is designed with a low hung drive, with the train of gears underneath the arm which drives the spindle off its largest diameter down close to the work. In order to overcome wearing the head bell-mouthed, the large driving gear is mounted on a large semi-steel sleeve mounted on the head in two large ball bearings. The spindle does not revolve on this sleeve but simply slides up and down in a double keyway and when it reaches its maximum travel of 18 in. it still maintains 7 in. of bearing in the sleeve, which is mounted in large ball bearings 18 in. apart. A pump in the head supplies oil to the gears and bearings.

The only part which connects the transmission to the head is the driving gear in the transmission to the driven gear mounted on the spindle sleeve. The bottom part of the transmission sets in oil in the bottom of the head. This unit contains the reverse for both the gears and their clutches, one for the forward drive and the other for reverse for tapping. The multiple clutch in the unit has seven driving discs in the forward drive and the same number in the reverse.

The outer column of the machine hangs on two ball bearings mounted on the top of the inner column, a large thrust bearing to take the weight and a large radial bearing to take the radial load of the swinging arm, together with roller bearings mounted on the bottom of the column. The clamping mechanism for binding the inner and outer column consists of a pair of eccentric wedges of crescent shape, mounted between the two columns. The column

can be locked either by a hand lever or a foot treadle as shown on the front of the base.

The arm binding levers point toward the operator and are eccentric on the binding end so that the operator pulls down on the lever to bind the arm and pushes up to release it. There is a mechanism in the arm to prevent the operator from trying to raise it while it is clamped. When the arm reaches its maximum travel at the top of the column, it is stopped automatically by a plunger and if it should meet any obstruction while being lowered, it again stops automatically. This is accomplished by a stationary screw and revolving nut. The screw hangs on a friction bearing at the top of the column. The revolving nut is mounted in ball bearings in the arm. The weight of the arm on the screw creates the friction to keep the screw stationary, but when the arm strikes or rests on any obstruction, it releases the weight of the friction and allows the screw to turn with the nut. The power for rotating this nut is received from the rear shaft through a set of hardened tumbler gears.

The variable speed motor is mounted in the arm with an 11-point rheostat directly connected to the head which gives 24 speeds. Variation of speed is obtained by revolving the pilot wheel just above the levers on the head. This attachment is mounted on the head and slides along the spline shaft in the rear.

Hose dismantling and assembling machine

THERE appeared on page 780 of the December, 1921, issue of the *Railway Mechanical Engineer* a description of one of the first hose dismantling and assembling machines made by the Covington Machine Company, Inc., Covington, Va. Since the publication of this description considerable improvement has been made in the machine.

The machine is designed for the single purpose of dismantling and assembling air, signal and steam hose used in railroad work. It is a self-contained, air-operated machine which needs no special foundation and can be set up on the shop floor under a shed or in any location convenient to an air line with from 85 lb. to 100 lb. pressure.

The changes in the design start with the frame *A*, Fig.

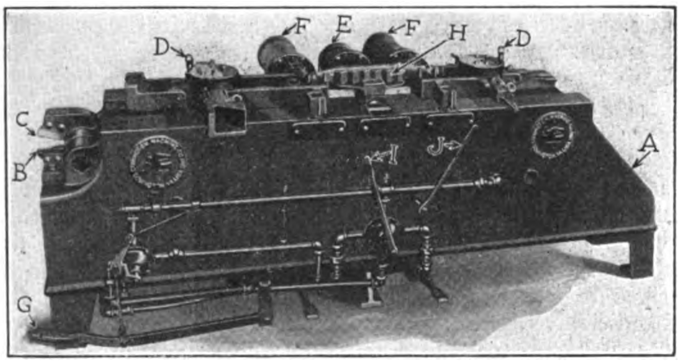


Fig. 1—Covington machine set to remove the couplings from both ends of the hose at one operation

1, which is made with cored openings in the top and out through the rear side, which allows the old metal parts when stripped from the hose to pass through the machine and drop into boxes. The knife block *B* and knife arm *C*, used for cutting the clamp bolts on the old hose, have been lowered below the top surface of the frame, allowing the sliding turret with the attached tools to pass over the top knife arm. Instead of a fixed sliding head, revolving turrets with all the dismantling and assembling tools mounted on them, have been mounted on the sliding crossheads. Thus, the tools are ready for instant use by simply removing the indexing pins *D* and revolving the turrets to bring the tools desired into working position.

A 6-in. clamping cylinder *E* has been mounted horizontally with the double pistons *F* for use when clamping old hose to be dismantled and holding new hose when assembling.

The methods of performing the various operations on the machine have been materially changed. The operations for stripping old hose are as follows: Referring to Fig. 1, the clamp bolts are first cut by the two knives *B* and *C* without injuring the hose clamps. The valve con-

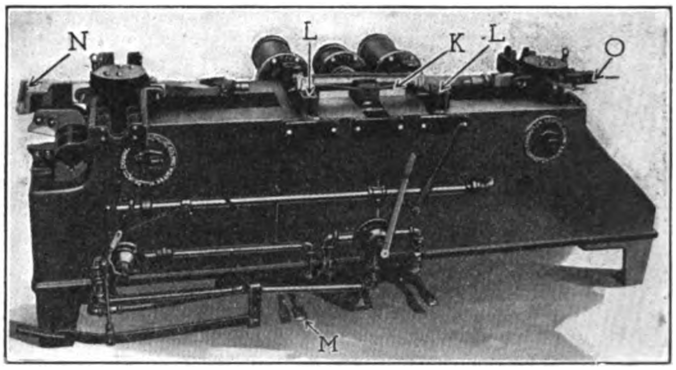
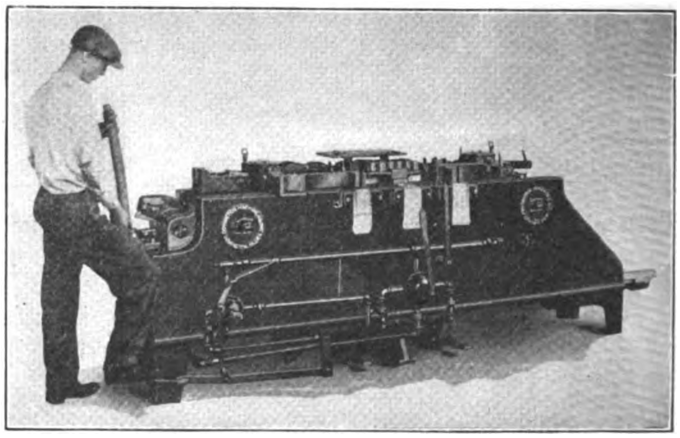


Fig. 2—Machine set for the first operation when assembling air or steam hose

trolling this operation is operated by the foot treadle *G*, thus leaving both hands free to hold the hose.

The operator now moves to the front of the machine and throws lever *I* to the left which brings the turrets



Performing first operation of shearing the clamp bolts on the hose

carrying the pulling blocks toward the center of the machine. The hose is then dropped in between the clamping head *H* with the coupling end of the hose to the left in the puller block, the coupling being in the larger opening and the clamp in the smaller opening. The nipple end

rests in the right puller block with the nipple in the larger opening toward the turret center and the clamp in the other opening. The lever J is now thrown to the right, clamping the hose in the heads H. Lever I is then thrown to the right, which, by means of a series of air operated levers, moves the pulling blocks away from the center of the machine, stripping off the nipple, coupling and clamps which drop through the frame of the machine. Lever I is then moved back to the left releasing the hose. The nipple, or coupling ends of either air, steam, or signal hose are handled in the same way, with the tools mounted on the revolving turret head.

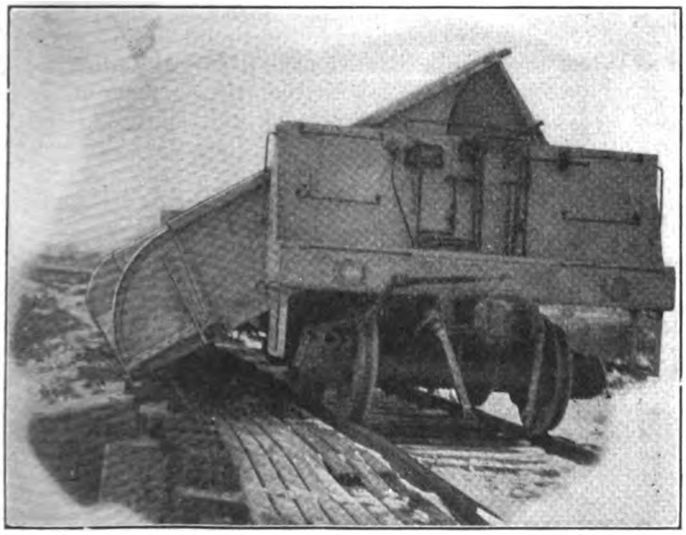
In assembling an air hose, a new hose is laid in the trough K, Fig. 2, with the fitting in each end and the two clamps loosely mounted. The heads L are brought toward the center of the machine by the operator stepping on treadle M, which squeezes the clamp around the hose while holding it in position. While holding the clamp in this position, the operator inserts a clamp bolt, puts on a nut and the hose is completely assembled. In assembling steam hose, the operation is exactly the same except that the assembler N is used for the coupling and the stem O for the nipple.

The speed of the machine depends on the operator's willingness to work. On test, one operator is said to have dismantled 240 standard air hose in 60 min., which is an average of one every 15 sec. The signal hose required a little longer time because of the small nipples, but 200 per hour were dismantled without trouble. The same operator assembled 55 standard air hose in 60 min. It required 60 min. to assemble 45 signal hose and 60 min. to assemble 35 steam hose.

Air dump car with traversing and tilting body

An air dump car with a capacity of 100,000 lb., a cubic capacity of 28 cu. yd. level full, or 43 cu. yd. with a normal crown load, has recently been placed on the market by the Differential Steel Car Company, Findlay, Ohio.

In dumping, the movement of the body is first a lateral movement across the underframe during which time the side folds down to the same plane as the floor. The body



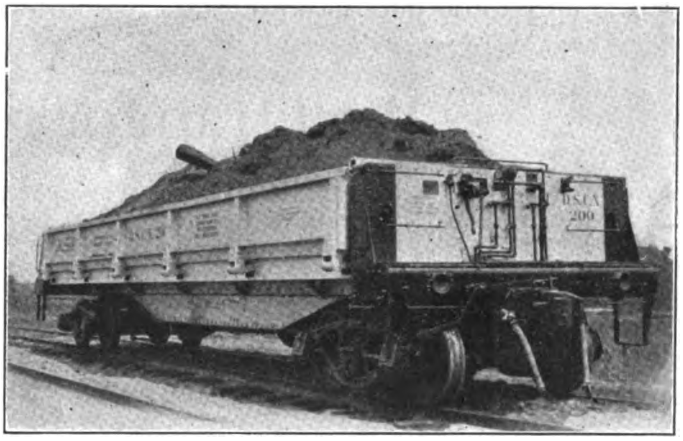
Differential dump car in the dumping position

then tilts and is balanced in all positions. The car is thus able to dump the material clear of the track. The dumping mechanism is so arranged that part of the load may be discharged without discharging the remainder, as it is easy to arrest the motion of the body at any desired angle and to bring the body back to the horizontal position. In this way material may be distributed when and where desired. It is equally as easy to dump to either side of the car as the air control lever governs the entire dumping operation which simply requires moving the control lever in the desired direction. There is no part of the car which offers any obstruction to the discharge of its load. This is particularly important in dumping large boulders where an obstructed opening would render discharge impossible. The floor of the car is perfectly smooth, with no projecting rivet heads or other obstructions which might impede the discharge of the load. The door is hinged in such a manner that there is always a sealed joint between the door and the floor. The door folds under the floor plate so that at no time is there a crack between the two.

The distance from the rail to the top of the sideboard is only 7 ft. This height may be further reduced for hand loading by the simple expedient of lowering the door, thus reducing the loading height to the floor level, which is about 4 ft. 6 in. above the rail. The operation of opening and closing the doors is executed by means of the air dumping mechanism. It is possible to operate the car on a pressure as low as 40 lb.

The dumping mechanism is provided with a mechanical interlock which keys the body to the underframe. This locking device operates as part of the dumping control. There is no chance of accidental dumping due to leaky valves or other causes.

The car is of all-steel construction, complies with A. R. A. standards, and is equipped with United States safety appliances. The body is supported on two lines of rollers



An air operated dump car with a traversing and tilting body

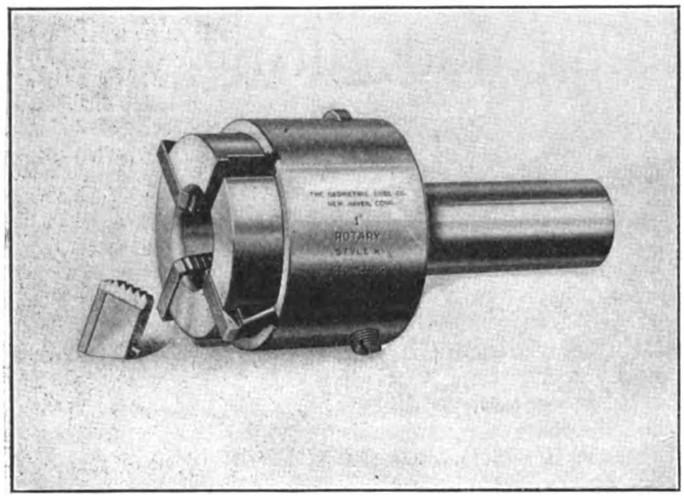
on 2-ft. centers and at 7-ft. intervals the full length of the car. These rollers operate in the raised sections of the floor. This method of support gives greater stability because the two lines of support are at about the same height as the center of gravity of the loaded body. It strengthens the floor of the car and renders the body much less likely to be damaged by heavy pieces of material being dropped into the car. These raised sections of the floor also serve as an excellent protection to the mechanism. The moving parts of the operating mechanism are

equipped with large bronze and graphite oilless bushings.

The car is dumped by means of a rugged air motor operating through a worm gear reduction, all enclosed in an oil-tight case. It is controlled by air and the control is so arranged that any number of cars may be dumped in a train from one car to either side in less than one minute. Any car may be locked so that it will not dump. An entire train may be dumped from the locomotive in either direction. The operator, standing on one of the cars of a train, can dump all cars ahead of him in one direction and all to the rear in the other. This control is universal so that any combination can be secured.

Rotary self-opening die head

The rotary self-opening die head shown in the illustration has been designed by the Geometric Tool Company, New Haven, Conn., with particular reference to the various types of multiple spindle automatics and other live spindle machines. Owing to its small diameter, it swings freely in the limited space afforded by many of the modern automatic screw machines.



Geometric Style K rotary self-opening die head

It is constructed in three units which are completely enclosed, thus keeping out dirt or chips from the mechanism. The opening and closing of the die head is effected by the forward and backward movement. It is designed so that the chasers project beyond the face of the die head, permitting threads to be cut to a shoulder without any adjustment, and also giving maximum chip clearance. All the working parts are ground, including the entire sliding surface of the slots in which the chasers are located.

The threading chasers, while in the cutting position, are rigidly supported on all sides and at the top; they are completely boxed in, except in the face, where the teeth are located. The wide slots in which the chasers fit allow them to be large in size, thus providing durability. The chasers can be instantly removed or replaced, for there is no removing of the face plate or screws in order to get the chasers in or out. This construction eliminates the necessity of lining up cam slots before the die head can be locked. Chasers for cutting left and right hand threads are interchangeable.

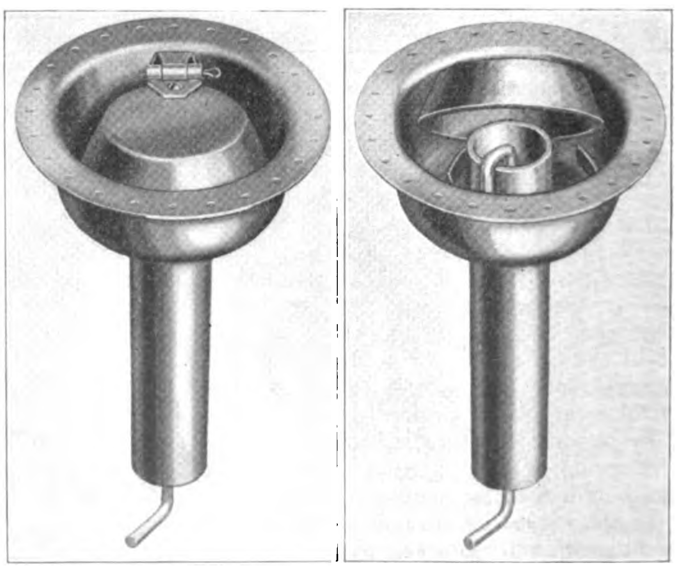
The die head is characterized by its simplicity in operation. When the spindle is advanced, a stop provided on the machine makes contact with the trip on the outside of the tool the moment the desired length of thread has been cut. This opens the die head. When the spindle is returned, the die head is closed by a yoke on the machine which makes contact with the rear of the die head closing sleeve.

This die head is known as Style *K* and is made to take the following stock sizes: 9/16 in., 1 in., 1¼ in. and 1½ in.

Well trap for refrigerator cars

A new well trap with permanently attached agitator has been developed for use in refrigerator cars by the Equipment Specialties Company, Chicago. The well trap itself is made of pressed steel and consists of a bowl and cap with a standard wrought iron overflow pipe, pressed into the bowl bottom flange and further secured by two ¼-in. hot driven rivets. The hinges are heavy and are well secured, being located where they can be readily inspected and the brass cotter pin easily applied. The drain is heavily galvanized and not likely to break owing to its pressed steel construction.

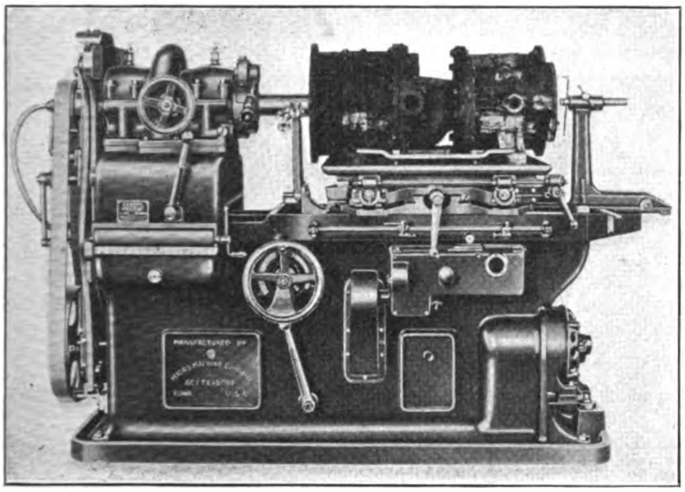
The agitator is a permanent part of the trap and is operated from the outside of the car. By its use the sediment or accumulation which collects in traps can be broken up and allowed to flow out of the overflow pipe, thus preventing the clogging of drains and flooding of car floors. The agitator reaches all parts of the bowl and is positive in effect. It also raises the flare-sided seal cap and further agitates the sediment. The cap of its own accord drops back into place and the water seal is again intact. Either a straight overflow pipe, or one with a 10-deg. offset from the vertical in order better to clear the journal box lid, can be provided.



Equipco well trap with cap closed and open to show the agitator

Internal grinder for railroad shops

THE illustrations show a new machine recently developed by the Micro Machine Company, Bettendorf, Iowa, and designed exclusively for grinding work in railroad shops. With suitable work-holding fixtures the machine will grind all bushing and pin holes in locomotive rods, running gear, air brake valve cylinders and similar parts. By means of a special swiveling table, air compressor cylinders can be ground



Micro internal grinder refinishing the worn cylinders of a cross compound air compressor

without unbolting them from the center castings and with the assurance when the job is done that the cylinders will be smooth, accurately round and without taper, and the axes in exact alinement, thus tending to prevent piston rod packing troubles and provide more efficient compressors. The standard range of the machine is 2½-in. to 10-in. holes, 13 in. deep. With special spindles, 1-in. to 15-in. holes, 19 in. or more in depth may be ground.

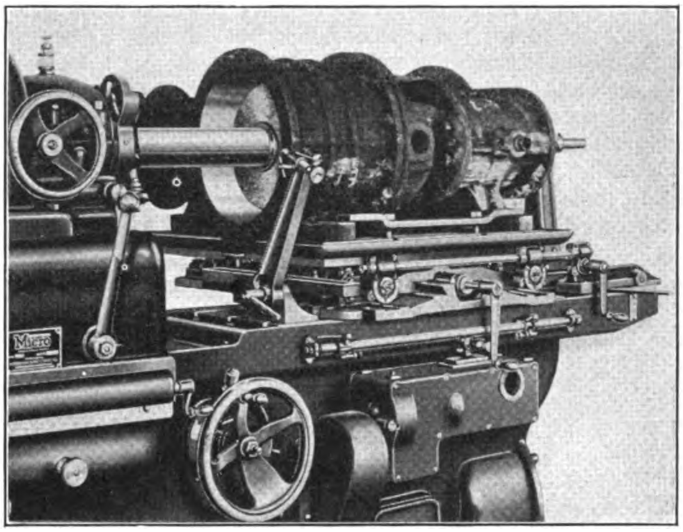
The Micro grinder has several new features of special interest. The driving motor and mechanism are a part of the machine, power being transmitted to the grinding spindle by a counterbalanced pantagraph arrangement which assures a constant speed of the grinding wheel without back lash of the belting and thus promotes more smooth, accurate work. By practically eliminating vibration from the source of power through to the finished job, maximum smoothness is assured.

An adjustable speed headstock is provided, enabling the correct relation between work speeds and wheel travel to be maintained. In determining the correct relation of these two variables, the builder conducted exhaustive experiments demonstrating that the orbital speed which is correct for a small hole is too rapid for a large hole and that, given the proper work travel, an unusual amount of stock (up to 1/32-in. in cast iron) may be removed in one cut regardless of the size of the hole. Orbital headstock speed control is one of the most important features of the new grinder.

The Micro grinder is equipped for wet grinding. During the operation, a cooling compound is forced through the center of the patented main spindle and centrifugal action throws it directly between the wall of the hole and the grinding wheel. By keeping the work cool distortion due to unequal expansion and contraction is prevented. The cooling compound then drains into a clarifier tank where all sediment and oil is removed assuring the delivery of clean grinding compound to the work.

Force feed lubrication is provided for both the headstock and the gear box. All oil holes are protected by filters to prevent dust and grit getting into the bearings, the lubrication being retained by special seals. There are five table feeds to take care of various depths of cut of the work. The eccentric feed can be made coarse or fine while the machine is in operation. For centering the work, rapid hand feed is provided.

The reverse gear box is an enclosed unit also provided with automatic force feed lubrication. The table change feed worm and gear box and all other running units are equipped with the Alemite system of lubrication. The drive for the machine consists of a 3-hp. motor located



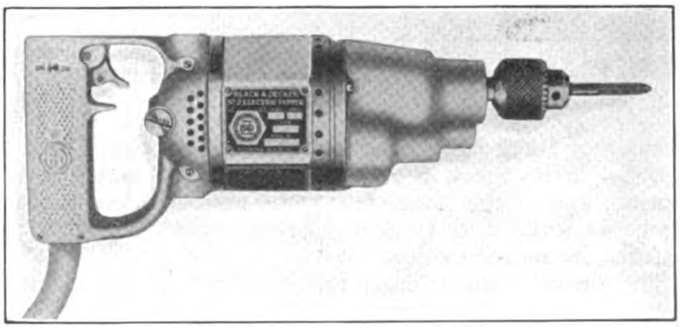
Close-up view showing compressor holder and swiveling table

in the rear end of the base and controlled by a friction clutch with a lever conveniently located near the operator on the front of the machine.

The Micro grinder is designed to combine precision and accuracy with a flexibility and ready change from one job to another which suits its demands.

Portable electric tapper

AN electric tapper with an automatic reverse is a recent addition made by the Black & Decker Company, Towson, Md., to its line of portable electric tools. It is similar in design and construction to the



Black & Decker electric tapper which has an automatic reverse

other electric tools made by the same company except that the mechanism in the gear case is so designed that

the tap is driven in at a speed of 350 r.p.m., by a slight backward pull on the machine, the tap chuck is automatically reversed and the tap backed out of the threaded hole at double the speed it is driven in, thus eliminating a reversing switch.

It is adapted to a wide range of work as it will tap holes in steel up to 1/4 in.; in cast iron, up to 3/8 in. and in brass or aluminum, up to 5/8 in. The machine weighs approximately 8 3/4 lb.

Melting furnace for soft metals used in railway shops

THE melting of soft metals for locomotive crossheads, driving boxes, etc., is an extensive practice in railway shops. A melting furnace adaptable to this class of work has been recently added to the line of gas furnaces and appliances manufactured by the Johnson Gas Appliance Company, Cedar Rapids, Iowa. It is fitted with a removable cast-iron melting pot with a capacity of 300 lb. of metal.

The pot has a removable lid and an outlet valve for drawing off the molten metal. The heating element

The Johnson 300 lb. capacity melting furnace

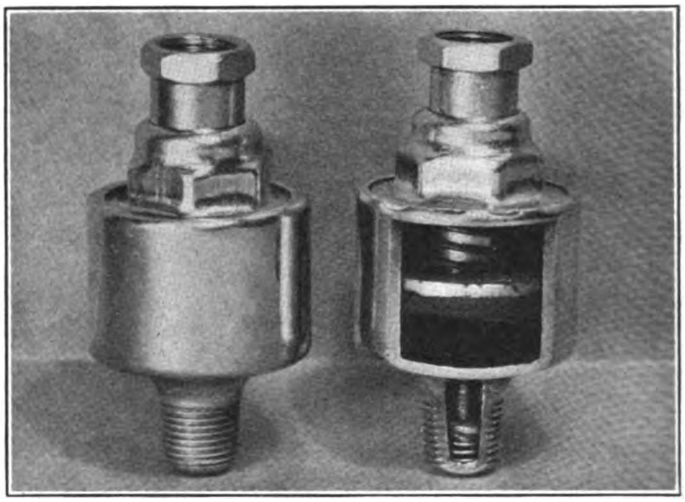
consists of three large direct-jet Bunsen burners. They are said to be equal to an air-blast outfit in rapidity of heating, and at the same time to be more economical in gas consumption and easier to operate which are desirable features for railway shops.

The furnace can be used for melting lead, tin, white metal, babbitt, solder scrap and all other low or medium fusion metals and alloys. It can also be used for cyanide hardening, oil tempering and the melting of various chemicals. The over-all height of the furnace is 31 in. and the weight complete is 185 lb. The gas consumption is 85 cu. ft. per hour.

National grease cup with an automatic feed

A GREASE cup designed to feed semi-liquid lubricants to shop machinery, elevators, shop trucks, etc., has been put on the market by the National Automatic Grease Cup Company, Chicago. This cup, which is substantially made, does not replace other lubricating systems, merely adding to them a reservoir containing sufficient semi-liquid grease or heavy oil for many hours of operation.

The cup does not require any special fitting for application as the top stem will accommodate any type of fitting. The position of this stem indicates when the cup is full or empty.



Automatic grease cup which is filled with a pressure gun

A uniform feed is obtained regardless of the pressure exerted by the spring on the main stem. The flow is controlled by a screw slot adjustment located in the lower shank of the cup. This slot is turned only in an anticlockwise direction. It is not necessary to remove any caps for filling as any type of pressure gun may be used for this purpose.

REPAIRING LOCOMOTIVE GUIDES.—An interesting exhibit was brought to the attention of railroad men at the National Railway Appliance Association's exhibition at the Coliseum, Chicago, recently. A new process for repairing locomotive guides was displayed, by means of which the General Electric Company claims to have eliminated all difficulties previously encountered in renewing these guides and keeping them up to I. C. C. standards.

The process used was electric arc welding automatically applied. The guides were placed in an ordinary lathe and the automatic welder was mounted on the tool post. When in operation, the guide remained stationary and the automatic welder traveled along with the carriage of the lathe, depositing electrode metal on the worn surface of the guide. The welding was applied on the side surface of the guide covering a width of 2 in., beginning on the inside and laying down adjacent beads, working to the outer edge. Two layers of beads were required to build up the worn spot, a total of 3/8 in. on each side. This was then machined away 1/8 in. on each side, leaving 1/4 in. finished built-up stock. The length of the built-up guide was 5 ft. A total of three hours was required for welding both sides using 150 amperes, 20 volts across the arc and 1/8 in. diameter electrode wire.

Figures obtained from a railroad now using this process indicate a saving of almost 50 per cent when automatic electric arc welding is used in preference to the oxy-acetylene process.

General News

Locomotive Inspection Bureau's February report

The Bureau of Locomotive Inspection in the month of February inspected 5,732 locomotives, of which 2,648, or 46 per cent, were found defective and 267 were ordered out of service, according to the Interstate Commerce Commission's monthly report to the President on the condition of railroad equipment. The Bureau of Safety during the same month inspected 96,249 freight cars, of which 3,803, or 3 per cent, were found defective, and 1,523 passenger cars, of which 27 were found defective. Twenty-two complaints, involving 50 violations of the safety appliance acts, were transmitted to various United States attorneys for prosecution.

Suit between Brown Instrument Company and Republic Flow Meters Company settled

The suit brought by the Brown Instrument Company in the Federal Court at Chicago against the Republic Flow Meters Company and certain individuals has been settled between the parties; also certain suits at law brought by the Republic Flow Meters Company and the same individuals in the same court against Richard P. Brown have been dismissed.

The officers of the Republic Flow Meters Company did not wish to be under the imputation of illegally using any of the original construction of the Brown instruments. It having been called to their attention that there were pending on behalf of the Brown Instrument Company patent applications covering some of these features, the Republic Flow Meters Company has changed the construction of its indicating and recording pyrometers for the purpose of avoiding infringement either of patents or of original design or construction of the Brown Instrument Company.

Wage statistics for 1924

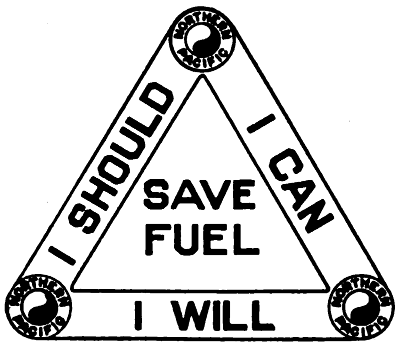
The Interstate Commerce Commission has issued a summary of railroad wage statistics for the twelve months ended with December, 1924, a consolidation of the monthly summaries heretofore issued, with certain minor changes.

The average number of employees reported for the year was 1,777,391, a decrease of 102,379, or 5.4 per cent, as compared with the preceding year. The total compensation was $2,867,564,802, a decrease of $175,596,361, or 5.8 per cent. Compared with the previous year, the average straight time hourly earnings for all employees reported on an hourly basis increased from 56.5 to 57.7 cents, and the average overtime hourly earnings increased from 76.8 to 80.4 cents. But owing to a reduction in the number of overtime hours worked, the percentage relation of overtime to total compensation decreased from 8.24 to 6.04.

The tables show, for employee groups: (1) the average annual compensation, the decrease in the average number of employees, and the increase or decrease in 1924, as compared with 1923; (2) the average straight time earnings per day or hour for the years 1924, 1923 and 1922, and last half of 1921; and (3) average earnings by districts for 1924. The reason for showing the last half of 1921 separately is that the present classification of employees became effective July 1, 1921. This is also the date of the general reduction in wages following the increases of 1920.

N. P. fuel economy slogan

"A scoop of coal dumped with the ashes in the clinker pit every time a fire is cleaned on a Northern Pacific locomotive would waste $15,000 a year. A single pound of coal wasted daily in each station stove would cost $7,000 a year. Savings in similar amounts may be effected with proper attention." So read the announcement of a fuel economy slogan contest open to every Northern Pacific employee, which ran from October 30 to December 10, 1924.



During the contest 2,100 slogans from nearly 450 participants were submitted. The winner of the first prize of $50 is J. J. Schmidt, chief yard clerk at the Fourth street yards, St. Paul, Minn. His slogan, accompanied by a triangular design about which the words are attractively grouped for display purposes, is shown in the illustration. B. M. Pederson, of the office of the auditor or freight receipts, St. Paul, was the winner of the second prize of $25. His slogan is "Coal, burn it as your own."

The slogan idea arose with the committee of the Northern Pacific representatives who attended the convention of the International Railway Fuel Association at Chicago last May. Practically every department on every division of the railroad was represented in the slogans submitted. The contest judges were C. L. Nichols, general manager; T. J. Cutler, mechanical superintendent, and M. M. Goodsill, assistant general passenger agent.

The first prize slogan will be used in the form of stickers and on envelopes, letter heads and engine equipment, including shovels. It will also be posted wherever coal is used on the railroad.

Locomotives ordered, installed and retired

Month 1924	Installed during month	Aggregate tractive effort	Retired during month	Aggregate tractive effort	Owned at end of month	Aggregate tractive effort	Building in R. R. shops
January	271	15,228,895	178	4,447,721	64,989	2,552,694,953	14
February	214	11,296,088	175	4,906,435	65,029	2,559,519,253	10
March	176	10,457,064	181	6,033,173	64,911	2,560,076,766	7
April	97	4,167,388	112	2,881,385	64,896	2,561,362,769	11
May	153	6,949,353	107	2,600,445	64,942	2,565,706,413	10
June	160	7,687,383	178	4,575,358	64,924	2,569,121,875	72
July	197	10,590,558	113	3,354,456	65,008	2,576,433,377	63
August	229	12,513,395	166	5,346,176	65,062	2,583,372,980	50
September	160	7,061,560	151	4,351,378	65,071	2,586,083,994	37
October	113	5,743,775	220	5,712,633	64,964	2,586,106,026	76
November	181	8,460,795	263	7,749,794	64,882	2,586,826,278	70
December	295	12,311,451	304	9,724,426	64,871	2,589,358,971	64
Total for year 1924	2,246	....	2,148	....	......	....	...
January, 1925	167	7,455,971	213	6,242,079	64,824	2,590,525,478	81
February	...	....	...	....	......	....	...
Total for 2 months	...	....	...	....	......	....	...

Figures as to installations and retirements prepared by Car Service Division, A. R. A., published in Form C. S. 56A-1. Figures cover only those roads reporting to the Car Service Division. They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

Pere Marquette has correspondence course in efficient car handling

A correspondence course for the instruction of its employees in the principles of efficient car handling as established by the present car service and Per Diem rules was arranged by the Pere Marquette several months ago. The course is available to all employees regardless of their occupation and 282 have enrolled in it. Although some dropped out after a few lessons, a considerable number have consistently studied and reported on the lessons submitted.

The course consists of six lessons, each accompanied by a list of questions which are to be answered and returned before the succeeding lesson is released. The answers to these questions are carefully checked to determine whether the employee has correctly interpreted the facts as given in the lesson and all misunderstandings are corrected by letter. The subjects discussed in the six lessons are as follows: Lesson No. 1 covers the general theory of car distribution with tables showing the ratio of loaded and empty car miles to total car miles, the average number of cars on line per day and the average miles per car per day, with explanations of the various terms used and methods by which the comparative statements are arrived at. Lesson No. 2 quotes car service rules governing the handling of empty cars of connecting railroads and charts the junction points of the Pere Marquette with connecting lines. Lesson No. 3 explains the Pere Marquette's system of car distribution, directing attention to the geographical location of the lines, as well as to the different kinds of freight general office car records, manifest freight and car tracing, and handled in local territories. Lesson No. 4 explains the interchange report and the Per Diem rule. Lesson No. 5 discusses the Lesson No. 6 is devoted to car demurrage.

C. M. & St. P. military organization

The 609th Engineers' Battalion of the United States Army, the military railway organization on the Chicago, Milwaukee & St. Paul, now has its commissioned personnel up to full peace strength, with 18 officers for the four companies, a headquarters company, an operating company, a maintenance of way company and a mechanical company. The enlistment of additional men for the ranks is now in progress, seven men having been enrolled already. This is believed to be the first reserve organization of its kind to have its commissioned personnel up to full peace strength. Norman A. Ryan, division superintendent at Terre Haute, Ind., where the battalion headquarters is located, is the commanding officer of the unit. The organization of the commissioned personnel of the battalion is as follows:

609th engineers' battalion (C. M. & St. P. Ry.)

Name	Grade	Civilian Duty	Location
		Headquarters	
N. A. Ryan	Captain	Superintendent	Terre Haute, Ind.
I. C. Jordan	Captain	Staff of Vice-president	Chicago, Ill.
G. M. Hayden	Captain	Chief Dispatcher	Tacoma, Wash.
H. G. Bernard	1st Lieutenant	Dispatcher	Ottumwa, Iowa.
E. A. Lalk	1st Lieutenant	General Agent	Milwaukee, Wis.
J. G. Bruce	1st Lieutenant	Agent	Bozeman, Mont.
		Company A (M. of W.)	
C. F. Allen	Captain	Roadmaster	St. Maries, Idaho.
N. F. Podas	1st Lieutenant	Assistant Engineer	Minneapolis, Minn.
V. Hansen	1st Lieutenant	Chief Carpenter	Montevideo, Minn.
R. V. Cummings	2nd Lieutenant	Freight Department	Great Falls, Mont.
		Company B (Mechanical)	
E. Jones	Captain	Engineer	Spokane, Wash.
J. H. Hale	1st Lieutenant	General Foreman	Galewood, Ill.
H. Wallace	2nd Lieutenant	General Foreman	West Clinton, Ind.
R. C. Visger	2nd Lieutenant	Locomotive Engineer	Chicago, Ill.
		Company C (Operating)	
F. R. Doud	Captain	Chief Dispatcher	Bellingham, Wash.
E. Kiesele	1st Lieutenant	General Yardmaster	Dubuque, Iowa.
C. G. Ellis	2nd Lieutenant	Locomotive Engineer	Milwaukee, Wis.
C. G. Gepner	2nd Lieutenant	Night Chief Dispatcher	Terre Haute, Ind.

C. M. & St. P. in receivership

On March 18 a receivership for the Chicago, Milwaukee & St. Paul was established by Judge James H. Wilkerson, United States District Court, at Chicago, who appointed as receivers H. E. Byram, president of the C. M. & St. P.; Mark W. Potter, who recently retired from the Interstate Commerce Commission, and Edward Brundage, former attorney general of the State of Illinois. It was decided by the board of directors that in all probability the road would be unable to meet the $48,000,000 maturities due on its bonds on June 1. The causes contributing to the company's present difficulties are considered to be as follows:

1. The competition of the Panama Canal, which, by reason of the low freight rates between the Atlantic seaboard and the Pacific Coast, and also to the Far East, via the canal, has been heavily felt by all transcontinental lines, and particularly by the Chicago, Milwaukee & St. Paul because of the large percentage of its investment in the Puget Sound extension.

2. The depressed agricultural and business conditions of the past few years in the Northwest, where a large part of the company's traffic originates. Passenger earnings, which were $31,034,000 it 1920, were only $21,768,000 in 1924, due largely to motor vehicle competition.

3. The large increases in the cost of labor and materials and in taxes, which have not been offset by corresponding increases in rates or in volume of traffic.

4. The lack, for a number of years, of surplus earnings to apply toward necessary improvements, betterments, etc., the consequences of which are that the current position of the company is unfavorable, and that its equipment has suffered deterioration and is insufficient in amount.

Court decisions

Non-compliance with labor board decision held not a conspiracy.—The Supreme Court of the United States has affirmed the decree of the Circuit Court of Appeals, Third Circuit, 1 Fed. (2nd) 171, affirming the decree of the Federal District Court for eastern Pennsylvania, 296 Fed. 220, dismissing the bill of the Pennsylvania Railroad System and Allied Lines Federation No. 90 against the Pennsylvania. The issues involved the construction and application of Title III of the Transportation Act of 1920, and the controversy was a continuation of that considered in Pennsylvania v. Labor Board, 261 U. S. 72.

The bill in the present case was filed to enjoin what was charged to be a conspiracy by the Pennsylvania and its officers to defeat the provisions of the Act and deprive the employees of the rights with which the provisions of Title III of the Act intended to vest them in their dealings with the company; averring that in the effort to deprive them of their proper representation and maintain the plan of the company, the company resorted to coercion with threats of discharge, and further violated their rights by preventing a large number of employees who were furloughed from casting their votes in the election.

The whole issue in the case, the Supreme Court said, "is whether Title III in pointing out what Congress wished the parties to the dispute to do was intended by Congress to be a positive, obligatory law. * * * The Supreme Court has decided that there is nothing compulsory in the provisions of the statute as against either the company or the employees upon the basis of which either acquired additional rights against the other which can be enforced in a court of law.

"What the complainants are seeking to do," the court said, "is to enforce by mandatory injunction a compliance with a decision of the Board not based on the legal rights of the parties, but on its judgment as to what legal rights the disputants should surrender, or abate in the public interest and in the interest of each other, to maintain harmonious relations between them necessary to the continuance of interstate commerce, and to avoid severing those

Freight car repair situation

1924	Number freight cars on line	Cars awaiting repairs: Heavy	Light	Total	Per cent of cars awaiting repairs
January 1	2,279,363	118,653	39,522	158,175	6.9
April 1	2,274,750	125,932	46,815	172,747	7.6
July 1	2,279,826	144,912	49,957	194,869	8.5
October 1	2,304,020	157,455	48,589	206,044	8.9
1925					
January 1	2,293,487	143,962	47,017	190,979	8.3
February 1	2,305,520	139,056	47,483	186,539	8.1

Month	Cars repaired: Heavy	Light	Total
December	87,758	2,073,280	2,161,038
March	77,365	2,213,158	2,290,523
June	70,480	1,888,899	1,959,379
September	74,295	1,372,277	1,446,572
December	66,615	1,288,635	1,355,250
January, 1925	69,084	1,358,308	1,427,392

Data from **Car Service Division** reports.

relations as they would have the strict legal right to do. Such a remedy by injunction in a court it was not the intention of Congress to provide."

The complainants also sought damages on behalf of the members of Federation No. 90. First, for employees on furlough when notified to return on the scale of wages made effective by the company July 1, 1921, who refused to return except on the old scale prevailing September 1, 1920, and who sought wages though they did not work. Second, employees who worked under the company scale for a year and then struck, who claimed the difference between the old and new scales. Third, those who did not strike, but accepted wages on the new scale, who claimed the difference between the two scales till the filing of the bill.

The court did not find it necessary to consider these claims on their merits. "Even if the Federation No. 90 and its members as representatives in a class suit in equity could recover such claims as damages incidental to granting the main equitable relief prayed for, the denial of the prayer for the equitable relief and the dismissal of the main part of the bill carries with it such incidental claims without prejudice to their prosecution at law by individual claimants as they may be advised."—Pennsylvania System and Allied Lines Federation No. 90 v. Pennsylvania. Decided March 2, 1925. Opinion by Chief Justice Taft.

Meetings and Conventions

American Railway Association headquarters for London Congress

The American Railway Association will have headquarters for its delegates to the International Railway Congress to be held in London on June 22 to July 12 at the Hotel Cecil, the Strand, London. Representatives of railways which are members of the association are invited to make use of the facilities at the headquarters, which will include translations into and from the French, stenographic service, assistance with bookings and the like.

American Welding Society

The annual meeting of the American Welding Society will be held on April 22, 23 and 24 at 29 West Thirty-ninth street, New York. The tentative program for this meeting is as follows:

Wednesday, April 22.

9:00 a.m.—Resistance Welding Committee meeting.
11:00 a.m.—Gas Welding Committee meeting.
2:00 p.m.—Electric Arc Welding Committee meeting.
8:00 p.m.—Educational Committee meeting.

Thursday, April 23.

9:30 a.m.—Business session American Welding Society.
1:45 p.m.—Inspection trip to Bay Way plant, Standard Oil Company.
7:00 p.m.—Annual dinner, Park Avenue Hotel.

Friday, April 24.

9:30 a.m.—Technical session.

Symposium.

1.—Methods of inspecting welds.
2.—Testing the skill of operators.

12:00 m. —Luncheon Engineers' Club.
12:45 p.m.—Technical session continued.
2:00 p.m.—American Bureau of Welding.
3:30 p.m.—Board of directors, American Welding Society.

Annual meeting of the Mechanical Division, American Railway Association

The annual meeting of the Mechanical Division, American Railway Association, will be held at the Drake Hotel, Chicago, June 16, 17 and 18, 1925. This meeting is to be strictly a business meeting and is confined to members authorized to represent and vote for the railroads, and members of committees. There is no objection to any railroad sending such representative members as they may desire. The business to be taken up will be the consideration of and acting upon reports of the various committees. In addition, two or three individual papers on important subjects will be presented and discussed. All voting representative members of the railroads are urged to be present, in order that proper consideration may be given to all committee reports and subjects coming before the Mechanical Division and proper action taken.

Wood Preservers' Association

On account of the growth of the work of the American Wood Preservers' Association, the office of secretary has been divorced from that of secretary-manager of the Service Bureau and E. J. Stocking has been appointed secretary with office at 111 West Washington street, Chicago. P. R. Hicks continues as secretary-manager of the Service Bureau of the association with office at 10 South La Salle street, Chicago, devoting his full time to the work of that organization. The Executive Committee of the Wood Preservers' Association has also reconsidered the action taken at the annual convention relative to the location of the next meeting and has selected Cleveland for the convention which will be held on January 26-28, 1926.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next meeting May 26-29, inclusive, Alexandria Hotel, Los Angeles, Cal.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin ave., Chicago.

American Railway Association, Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Business meeting to be held in Chicago June 16, 17 and 18. No exhibit of railway supplies and machinery will be held.

Division V.—Equipment Painting Section.—V. R. Hawthorne, Chicago. Next meeting September, 1925.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York. Next meeting May 19, 20 and 21, at St. Louis, Mo.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention August, 1925, Hotel Sherman, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division. A. F. Steubing, Bradford Corp., 25 West Forty-third street, New York. Spring meeting May 18 to 21, inclusive, Milwaukee, Wis.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting, June 22-26, Chalfonte-Haddon Hall, Atlantic City, N. J..

Association of Railway Electrical Engineers—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 20-24, Hotel Sherman, Chicago.

Canadian Railway Club.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings second Thursday each month, Hotel Statler, Buffalo, N. Y. Next meeting April 9. Paper on billing in transit, mixing in transit and reconsigning will be presented by W. B. Errington, local freight agent, Nickel Plate, Buffalo.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland. Next meeting April 6. Paper on Oxy-acetylene process will be presented by G. C. Harcke. A film "Oxygen the Wonder Worker," will also be shown.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention, Hotel Winton, Cleveland, Ohio, August 18, 19 and 20.

International Railway Fuel Association.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill. Next annual convention May 26-29, Hotel Sherman, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Annual convention September 8-11, Hotel Sherman, Chicago.

Master Boiler Makers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Next convention May 19-25, Hotel Sherman, Chicago.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting April 14. A paper on purchases and stores will be presented by C. D. Young, Pennsylvania railroad.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Next meeting April 17. Prof. W. M. Daniels, Yale University, will speak on what branches of transportation technical schools and universities attempt to teach. Entertainment by B. & O. Glee Club.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Next meeting April 9. Paper on Manufacture of Pure Iron, by T. Faw, California Corrugated Culvert Company, and a paper on the Reclamation of Railway Springs, by F. H. Pelle. E. F. Houghton Company, will be presented; also motion pictures illustrating the manufacture of pure iron.

Railway Club of Greenville.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in each month, except June, July and August.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

Traveling Engineer's Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September 15-18, 1925, Chicago.

Western Railway Club.—Bruce V. Crandall, 189 West Madison St., Chicago. Annual meeting May 23, Edgewater Beach Hotel, Chicago.

Supply Trade Notes

The Lehon Company, Chicago, has moved its New York office from 95 Liberty street to 60 Broadway.

The General Piston Ring Company, Indianapolis, Ind., has moved its plant and offices to Tipton, Ind.

The Hubbard Steel Foundry Company, East Chicago, Ill., is constructing a machine shop, 150 by 120 ft.

C. C. Fredericks, vice-president and general manager of the W. N. Matthews Corporation of St. Louis, Mo., has resigned.

C. R. Naylor, sales agent of Symington Company at 2108 Straus building, Chicago, has been appointed manager western sales.

The Standard Stoker Company has removed its New York City office from 5054 Grand Central Terminal to 350 Madison avenue.

The Jordan Machine Company, Minneapolis, Minn., will construct a one-story and basement machine shop addition 70 by 120 ft.

R. M. Taylor, assistant general manager of the Thomson Electric Welding Company, has resigned to go with Congoleum-Nairn, Inc.

The Woodman Railway Supply Company, Railway Exchange building, Chicago, has been incorporated to take over the sale of journal boxes, including the Joliet and Franklin boxes, formerly handled by the Northwestern Malleable Iron Company, Milwaukee, Wis. Officers of the new company are, president, G. A. Woodman, sales manager of the Northwestern Malleable Iron Company; vice-president and secretary, A. M. Talbot, vice-president of the A. H. Talbot Company; treasurer, A. M. Tufts, manager of the Commercial Utilities Company. Mr. Woodman was born in Dunkirk, N. Y., in 1866, and in 1883 entered the employ of the Brooks Locomotive Works as a machinist, later becoming a draftsman. In 1887 he was appointed mechanical engineer of the Milwaukee & Northern, now a part of the Chicago, Milwaukee & St. Paul, which position he held until 1889, when he returned to the employ of the Brooks Locomotive Works as a draftsman. From 1891 to 1895 he was a draftsman for the Illinois Central and in the latter year was appointed chief draftsman of the Lima Locomotive & Machine Company. In 1897 he was appointed assistant master car builder of Swift & Company, Chicago, which position he held until 1898 when he was appointed assistant superintendent of the American Car & Foundry Company, Chicago. In 1900 he became mechanical engineer in charge of production of the Kirby Equipment Company, Chicago, which position he held until 1912 when he became sales manager of the Northwestern Malleable Iron Company, with headquarters in Chicago.


G. A. Woodman

Charles A. Swan has been appointed assistant manager of steel sales at the Timken Roller Bearing Company, with headquarters at Canton, Ohio.

The Bettendorf Company, Bettendorf, Iowa, plans the construction of a three-story office building 76 ft. by 137 ft., to cost approximately $175,000.

The Welding Service & Sales Company, Donovan building, Detroit, Mich., of which T. M. Butler is manager, has been appointed agent in the Detroit territory for the Gibb Welding Machines Company, Bay City, Mich., for its arc, spot and seam welding machines.

A. H. Beale, president of the Lebanon Iron Company, Lebanon, Pa., has resigned to become president of the A. M. Byers Company, Pittsburgh, Pa.

The McGill Manufacturing Company, Valparaiso, Ind., has appointed the J. G. Pomeroy Company, San Francisco, Cal., its Pacific coast representative.

A. Van Hassel, secretary of the Magor Car Corporation, with headquarters at New York, has been elected also vice-president. The company's works are at Passaic, N. J. Mr. Van Hassel was born on November 12, 1889, in Paterson, N. J. He received his education in the grammar and high schools of that city. His first position was with the Rogers Locomotive Works. He subsequently entered the service of the Cook Locomotive Works in Paterson, N. J. Mr. Van Hassel became associated with the Magor Car Corporation in 1909, and served in various capacities until 1921 when he was elected secretary. Mr. Van Hassel is also assistant treasurer and assistant secretary of the National Steel Car Corporation, Hamilton, Ontario.


A. Van Hassel

The John H. McGowan Company, Cincinnati, Ohio, has bought the Twinvolute Pump & Manufacturing Company, Newark, N. J., builders of centrifugal pumps.

The National Malleable & Steel Castings Company, Cleveland, Ohio, has moved its Chicago sales office from 311 Railway Exchange to 501 Railway Exchange.

John Luther Nicholson, president of the Locomotive Firebox Company, with headquarters in Chicago, died on March 23 of pneumonia. Mr. Nicholson, who was born on June 25, 1875, in New York, was first employed at Chicago assisting his father, who was master mechanic on the South Side Elevated Railroad Company at the time of its construction. In October, 1895, he entered the employ of the Chicago & North Western as a locomotive fireman on the Wisconsin division. Later he worked extra in the same position on the Galena division. In July, 1902, he was promoted to engineman and in 1903 was promoted to assistant road foreman of engines on the Wisconsin division. He held this position until April, 1905, when he became associated with the American Locomotive Equipment Company, Chicago, to handle the sale of hollow arches for locomotives, of which he was one of the inventors. Later he entered business for himself to handle the sale of appliances which he invented. In 1918 he invented the thermic syphon and organized the Locomotive Firebox Company, taking charge of its manufacture and sales as president.


J. L. Nicholson

J. J. Flaherty, formerly in charge of welding for the Boston Elevated Railways, has been appointed director of sales of the Page Steel & Wire Company, with headquarters at Bridgeport, Conn.

The Yost Manufacturing Company, Meadville, Pa., has opened an office and warehouse at 25 South Jefferson street, Chicago, with H. S. Huncke in charge.

H. B. Warren, Cincinnati sales representative of the Thomson Electric Welding Company, has been made sales manager of the company, with office at Lynn, Mass.

E. H. Batchelder, Jr., Lytton building, Chicago, has been appointed western railroad representative of the varnish and enamel division of the Beaver Products Company.

The General American Tank Car Corporation and the General American Car Company have moved their general offices from the Harris Trust building to the Illinois Merchants Bank building, Chicago.

W. L. Bryson, formerly district manager of the Beaver Products Company, Kansas City, Mo., has been appointed manager of the St. Louis division of the Celotex Company, with headquarters in St. Louis, Mo.

H. F. Welch, in charge of railroad sales of the Niles-Bement-Pond Company, New York, has been appointed sales manager of the New York district. Mr. Welch will also continue to perform his former duties.

The Union Railway Equipment Company, Chicago, has discontinued its sales arrangement with Hope E. Scott & Co., Ltd., of Montreal, Que., and in future until further notice all Canadian business will be handled direct from the general offices, Chicago.

William Bonn, formerly assistant general sales manager of the auto body plant of the Pullman Company, has been appointed assistant general manager of the W. M. Laylor Company, railway sales representatives of the Zapon Company, with headquarters at Chicago.

W. R. Quinn, former manager of the fuel oil department of the Combustion Engineering Corporation, New York, has been appointed Pacific Coast agent, with headquarters at San Francisco, Cal. Mr. Quinn's territory will include Washington, Oregon and California.

Harry A. Flynn, who has served as general air brake supervisor of the Delaware & Hudson since 1904, has been appointed mechanical representative of the New York Air Brake Company in the New England territory, with headquarters at Boston, Mass. He succeeds N. A. Campbell, deceased.

C. E. Shearer has been appointed advertising manager of the Industrial Works, Bay City, Mich., and A. R. Olsen has been placed in charge of the art department. It was erroneously stated in the February issue of the *Railway Mechanical Engineer* that Mr. Olsen had been appointed advertising manager.

Allan M. Cullum has been appointed to the sales force of the Reading Iron Company, Reading, Pa. His headquarters will be at the general office of the company in Reading. R. I. Fretz has been placed in charge of marketing boiler tubes. Mr. Fretz formerly represented the Bethlehem Steel Company and the Midvale Steel & Ordnance Company for a number of years. He has been a student of metallurgy and metallography and spent some time in the Reading Iron Company's plant with a view to securing a working knowledge of its methods.

The Whiting Corporation, Harvey, Ill., has appointed new sales agents as follows: Snyder Foundry Supply Company, Los Angeles, Cal.; S. G. Elbe, Inc., 211 Tramway building, Denver, Colo.; Edward S. King, 306 Elmhurst building, Kansas City, Mo. Bradford H. Whiting, vice-president and general manager of the company, and president of its subsidiary, the Grindle Fuel Equipment Company, on account of ill health has resigned and severed his connections with these companies. Mr. Whiting has also given up his directorship in both companies.

Harry W. L. Porth, assistant master car builder of Swift & Co., Chicago, and president of the Chicago Car Foremen's Association died on March 2 in Chicago. Mr. Porth was born on January 18, 1889, in Utica, Kans. He entered the employ of Swift & Co. in April, 1912, as an engineer in the mechanical department at Kansas City, Mo. During the next few years he was promoted to assistant master mechanic and was transferred to the car department, Chicago, as a sub-foreman. In December, 1917, he was promoted to assistant master car builder, which position he held until his death.

Trade Publications

Pinch bug riveters.—Bulletin R-202, illustrating and describing Shepard pinch bug riveters, has been issued by the Hanna Engineering Works, Chicago.

Storage tanks.—A 12-page folder descriptive of cast iron storage tanks for all industries where storage and materials transfer are needed, has been issued by the Conveyors Corporation of America, Chicago.

Welding electrodes.—The characteristics and applications of three types of welding electrodes, designated as Types A, B and C, are described in a 16-page illustrated booklet, entitled "G. E. Welding Electrodes," which has been issued by the General Electric Company, Bridgeport, Conn. Brief instructions covering the use of each type are also given.

Machinery and tools.—General catalogue, No. 138, listing a complete line of machinery, tools, cutters, attachments, etc., has been issued by the Brown & Sharpe Manufacturing Company, Providence, R. I. Each piece of equipment is illustrated, and detailed descriptions as well as tabulated specifications and dimensions are given. The catalogue contains over 600 pages and is of a convenient pocket size.

Steel preservative paints.—A 24-page, illustrated booklet has been issued by Toch Brothers, New York City, which describes the various forms of steel preservative paints which this company manufactures. The text matter includes a detailed description of each of the various kinds of paints, the purpose for which it is best fitted, and the recommended manner of applying it. This subject-matter is indexed at the back of the booklet with general headings covering types of construction and character of surface. The illustrations show a variety of structures protected by the paints of this company.

Drinking water appliances.—Sanitary drinking water appliances manufactured particularly for railroad service by the Henry Giessel Company, Chicago, are described in a fully illustrated, 29-page catalogue, recently issued by this company. The catalogue is in loose leaf form so that new bulletins issued by the company can be readily included from time to time and the catalogue thus kept up to date. Sanitary drinking water coolers, filters, cooling apparatus and auxiliary appliance are described in the catalogue. A full page is devoted to the attractive monogrammed name plate which the company provides with all equipment.

Plibrico furnace lining.—The Plibrico Jointless Firebrick Company, Chicago, has issued a 36-page catalogue of standard filing size, 8½ by 11 in., a large section of which is devoted to the proper installation of monolithic furnace linings. This section, step by step, tells how monolithic linings should be installed. Another section gives the reasons for the superiority of this type of furnace lining over other and less modern types. Sections describe the use of this lining for furnace fronts, arches, side walls, and bridge walls in boiler furnaces and for heating furnaces, baking ovens, stills and other industrial furnace and miscellaneous applications. There is an interesting section on lining furnaces under oil-burning boilers.

Dump cars.—Facts covering three basic designs of dump cars: the first, a car of the lifting door type; the second, a car of the lifting door type in combination with an outward folding chute, and the third, a car with an outward folding door, making the door of the car when in a dumped position a continuous slope in conjunction with the floor, are contained in Catalogue D, a neatly arranged booklet of 22 pages which has been published by the Magor Car Corporation, New York. Each of these three basic designs, subdivided into different cubical and weight capacities, depending on the service for which they are required, are illustrated in both loading and dumping positions. Lists of specialties with which the cars are equipped and specifications accompany the illustrations. Inserted between each page of descriptive data are blue print drawings showing details of construction. The cars, which are of the automatic or hand operated type for standard or narrow gage roads, are built for railroad, mining, contractors or industrial service.

Personal Mention

General

Robert Draycott has been appointed traveling fireman of the Central division of the Central of New Jersey.

W. C. Smith has been promoted to assistant to the chief mechanical officer of the Illinois Central, a newly created position.

R. J. Howard has been appointed superintendent of shops of the Pacific Fruit Express at Colton, Cal., succeeding James King.

W. H. Bender, shop superintendent of the Missouri Pacific at St. Louis, Mo., has been appointed mechanical inspector, with the same headquarters.

George G. Lynch, chief draughtsman of the Atlantic Coast Line, has been appointed assistant mechanical engineer, with headquarters at Wilmington, N. C.

L. E. Cartmill, superintendent of shops of the Pacific Fruit Express, with headquarters at Los Angeles, Cal., has been promoted to assistant general superintendent of the car department, with headquarters at San Francisco, Cal.

E. L. Johnson has been appointed assistant engineer of materials and equipment tests of the New York Central, his former positon—that of engineer of service tests—having been abolished and its duties taken over by E. C. Hardy, general inspector.

H. S. Peck, train lighting maintainer of the Chicago, Milwaukee & St. Paul, with headquarters at Milwaukee, Wis., has been promoted to supervisor of locomotive and power plant operation, with headquarters at Chicago, a newly created position. Mr. Peck was born on March 27, 1889, at Roy, Mont., graduating from Montana State College in electrical engineering in 1911. He entered railway service as a draftsman, inspector and designer in the electrification department of the Chicago, Milwaukee & St. Paul, in which position he remained until the fall of 1917, when he entered the United States Army, serving in France on the technical staff of Chief of Engineers of A. E. F. Department of Construction and Forestry, until July, 1919. Mr. Peck re-entered railway service in the office of the general superintendent of motive power of the Chicago, Milwaukee & St. Paul, being appointed train lighting maintainer on January 1, 1924, which position he held until his recent promotion to supervisor of locomotive and power plant operation.

F. H. Adams, whose promotion to mechanical valuation engineer of the Atchison, Topeka & Santa Fe, with headquarters at Topeka, Kans., was reported in the February issue of the *Railway Mechnical Engineer,* was born on April 15, 1868, in Mississippi. He attended the University of Minnesota from 1885 to 1887, entering railway service in September of the latter year as a special apprentice on the St. Paul & Duluth, now a part of the Northern Pacific. He entered the service of the Gulf, Colorado & Santa Fe in February, 1891, in the office of the superintendent of machinery. He was promoted to engineer of shop extensions in November, 1901, and held that position until February, 1914, when he resigned to enter the Bureau of Valuation of the Interstate Commerce Commission. Mr. Adams returned to the Atchison, Topeka & Santa Fe in November, 1921, being assigned to special work in connection with the settlements with the Railroad Administration for under-maintenance of equipment during the period of federal control. He was later promoted to mechanical valuation assistant, which position he held until his recent promotion to mechanical valuation engineer.

Master Mechanics and Road Foremen

G. H. Warning has been appointed master mechanic of the Canadian National, with headquarters at Regina, Sask.

John B. Starbuck has been appointed road foreman of engines of the Sacramento division of the Southern Pacific, with headquarters at Roseville, Cal.

George B. Weller has been appointed assistant road foreman of engines of the Central division of the Central of New Jersey, with headquarters at Jersey City, N. J.

W. F. Laure, general foreman of the Illinois Central, with headquarters at Memphis, Tenn., has been promoted to master mechanic to succeed O. A. Garber, resigned to accept service with another company.

Henry C. Stevens has been appointed master mechanic of the Alamosa division of the Denver & Rio Grande Western, with headquarters at Alamosa, Colo. Mr. Stevens was born at Camden, S. C., on July 2, 1876. He attended the Waycross, Ga., high school and completed a mechanical course in the C-5000 class of the International Correspondence School of Scranton. He entered the Plant System shops as a machinist apprentice at Waycross in November, 1890. He then served as inspector of pumps and elevators from Savannah, Ga., to Jacksonville, Fla., on the Brunswick & Western, and as machine foreman at Waycross. In 1901 he became general foreman of the Atlantic Coast Lines at Montgomery, Ala.; in 1903, mechanical draftsman of the Gillon Machine Company at Waycross; in March, 1905, general foreman of the Montgomery district of the Mobile & Ohio, and in March, 1910, master mechanic of the Denver & Rio Grande at Alamosa. In March, 1918, he was transferred to the Burnham shops at Denver, Colo., serving as shop superintendent throughout the war period and the building of new shops at that point. He returned to the Alamosa division as master mechanic on February 15.

H. C. Stevens

Obituary

F. L. McClennan, foreman of the brass shop, rolling stock department, of the New York Central at West Albany, N. Y., died on February 20. Mr. McClennan entered the employ of the New York Central in March, 1901, as foreman of the brass shop.

John Howard, superintendent of motive power of the New York Central, with headquarters at New York, died suddenly on March 24. Mr. Howard entered the railway service as a machinist apprentice on the Pennsylvania at Renovo, Pa., and from 1883 to 1884 was successively machinist apprentice and locomotive inspector on the New York, West Shore & Buffalo (now a part of the New York Central) at Kingston, N. Y. From 1884 to 1891 he was foreman of the enginehouse of that road at Frankfort, N. Y. In 1891, he become general foreman; and in 1892 master mechanic of the River division of the West Shore at New Durham, N. J. He was promoted to superintendent of motive power and rolling stock of the Pennsylvania division of the New York Central at Corning, N. Y., in 1901 and, in 1902, became superintendent of motive power of the Western division of the same road at Depew, N. Y. From May, 1904, to November, 1904, he was superintendent of motive power and rolling stock of the Boston & Albany at Boston, Mass., and on November 1, 1904, became superintendent of motive power of the New York Central at New York.

J. Howard

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Railway Mechanical Engineer

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Rational car inspection

Unquestionably the interchange inspection and terminal inspection of railway cars is of great importance. The methods of inspection are important, as are also the thoroughness and rapidity with which the work is carried on. Without adequate inspection, the safe movement of all passengers and passenger equipment, freight and freight equipment handled in train service, would be impossible. Therefore the business of inspecting cars is second to none in importance on the railroads and should attract to this service men of intelligence, keen perception and reliability, who have a full understanding of their duties and responsibilities.

The business of inspecting cars calls for the display of much judgment and good, sound common sense. How many times are cars delayed and material wasted because of too technical inspection and too much emphasis on the letter rather than the spirit of the law? Too technical inspection as opposed to rational car inspection is quite likely to be the rule after a wreck on the line has caused the inspection forces to be called to account, although the wreck is far more often caused by failure to observe defective parts rather than laxness in maintaining the rules. The demands for economical operation are fully as pressing in railroading as in any other line of business and therefore rational or reasonable inspection should at all times be the ideal toward which car inspectors strive.

A waste in gas cutting

Considerable credit for the development of good welding and cutting practice in this country must be given to the careful and conscientious experimental work which has been carried on in the railroad shops of this country. Practically every railroad has made it its business to try out all the various processes on practically every kind of metal and on account of the necessity for taking certain safety precautions, a large part of this experimental work has resulted in the standardization of methods and proper regulations for all the processes. There has been, however, little done towards the improvement of one phase of this work and that is the use of the torch for cutting scrap material. Undoubtedly, the largest proportion of this work is performed in cutting up scrap metal in the car repair yard and at the scrap dock, and for some reason there seems to be a tendency to give the least amount of thought and attention to the finer details of operation in this work. The cutter who is engaged in it necessarily operates under a number of disadvantages which prevent him from making the speed and maintaining the low gas cost which is possible under conditions where output is a more important factor. Perhaps the principal reason for neglecting this study of cutting scrap material is because it is scrap. There are instances where a considerable saving has been accomplished by devoting a reasonable amount of study to this particular phase of shop work. If your gas cutting costs are too high, perhaps you will find the wasted gas and wasted time in the scrap pile.

Safety is not enough

The periods at which the various parts of the air brake equipment require attention in order to keep them functioning properly have been very well established. Practically every railroad has instruction pamphlets, circular letters, etc., in force outlining the attention that should be given to different parts and stating the periods at which it should be given. Very little trouble is experienced where the instructions are followed closely, which indicates that this is the policy that should be followed in order to attain the desired efficiency. However, instances have occurred where the instructions were found to be at fault relative to the time assigned for periodic inspections.

It is well to keep in mind that the limits established by the Interstate Commerce Commission are limits beyond which the device is not permitted to remain in service. It is evident that there may be cases where the device will not be in good working condition for a considerable period of time before it reaches the condemning limits. For example, the Interstate Commerce Commission requirements for the capacity of an 8½-in. cross compound air compressor are that the pump must maintain 60 lb. main reservoir pressure, the air escaping from the main reservoir through an orifice 9/32-in. in diameter, and the speed of the pump not to exceed 100 strokes per minute at an altitude not to exceed 1,000 ft. This test, which is required every three months, merely determines the efficiency of the air end of the pump. The number of strokes, however, can be increased by leakage past packing rings, air valves, piston rod packing, and to some extent by carbonized ports and passages. An air compressor, other than the cross-compound, operating at its best is not economical in its use of steam as no means has been provided for utilizing the expansive force, and anything that causes an increase in the number of strokes necessary to maintain pressure is wasting fuel, even with the cross-compound air compressor.

Another example of a device that can cause considerable waste and a possible air brake failure, is the feed valve. An entire air brake equipment may be seriously affected by a feed valve which is not functioning properly. It gets out of order easier than other parts and considerably more depends upon its successful operation than, for example, a single brake cylinder.

There are too many air brake inspectors and repair men inclined to let repairs to their equipment go to the limits prescribed by law as being in a safe and suitable condition

for service. The majority of delays due to air brake defects can usually be traced directly or indirectly to the failure on the part of someone to do the thing which should have been done at the proper time. From the standpoint of economy it is essential that each part function properly in its relation to the other parts of the air brake equipment. The most successful way to prevent waste through the operation of air brake equipment is to see that the instructions require that attention be given to the various parts at periods estimated to secure efficient operation and not merely to comply with the law.

The Foreman's Job

Last fall the *Railway Mechanical Engineer* announced a competition for the best articles dealing with the opportunities and responsibilities of the foreman. The contest closed on December 1, 1924. The decision of the judges has been delayed for two reasons. In the first place the competition proved to be one of the most successful that we have ever held, judged on the basis of the number of manuscripts that were received. In addition to this, however, the grade of the material was high and some difficulty was found in classifying it and coming to a final decision as to the two prize winners. The articles as they were submitted to the judges had the names of the competitors and all identification marks removed and were designated by number. In checking up we find that the first prize of $50 goes to "Bill Brown." This is a nom de plume, the writer preferring, for various reasons, to keep his identity secret. We can say, however, that he is a superintendent of a large and one of the most successfully operated railroad shop plants in the United States. The second prize of $35 goes to John H. Linn, assistant supervisor of apprentices, Atchison, Topeka & Santa Fe, Topeka, Kans. No third prize was offered, but at the suggestion of the judges we are adding a third prize of $25 for the contribution submitted by J. W. Murphy, the general foreman of the Boston & Albany at West Springfield, Mass. Several of the other articles crowded the prize winners pretty hard and these will be published during the coming months, particularly since they present more or less widely varying viewpoints. The first prize article will be published in our June number and will be accompanied by the results of a study which we have been making as to the practices of the various railroads in coaching and training the foremen to develop their leadership ability. A study of the articles which were received in the competition indicates that a very widespread and deep-seated interest is being shown in this question.

A maintenance department for motor cars

The utilization of the rail motor car for handling traffic on lines where business is light has already passed the experimental stage on a number of railroads. The Chicago Great Western has been among the leaders in adopting the motor car for this type of service and the mechanical department of this road has made special efforts towards solving the problem of maintenance on this particular type of equipment. The reader can gain considerable information relative to motor car maintenance from the abstract of a paper published on another page of this issue, by E. J. Brennan, superintendent of motive power, Chicago Great Western, Oelwein, Iowa, which was read before the Minneapolis section of the Society of Automotive Engineers. The Chicago Great Western has found it necessary to develop a gas engine department for the care of its motor cars and this department is in a great degree responsible for their successful performance. The gas car organization includes a motor car expert who is on the immediate staff of the superintendent of motive power and his jurisdiction extends over the entire system. It is his business to see that the cars are properly maintained and that the enginemen who want to qualify as motor car operators are properly instructed. The main shop at Oelwein has a gas engine repair organization for performing heavy and medium repairs, consisting of a foreman and several mechanics, helpers and apprentices who are engaged in gas engine work entirely. Light repairs on cars laying over at the engine terminal are performed by a specially trained gas engine mechanic. The Chicago Great Western is now considering the building of a separate repair shop somewhat removed from the main locomotive repair shops, owing to the fire hazard existing in motor car maintenance.

It is well to bear in mind that as new equipment of this type is purchased it must be maintained. The principal reason for buying motor equipment is to reduce operating expense and it is the job of the mechanical department to see that the expense of maintenance is kept at a minimum. This can be done if the responsible mechanical department officers make it their business to see that proper steps are taken towards placing the work of maintenance on the right basis at the beginning so that it can be developed as the number of motor cars increase. It is harder to reorganize a system which has been allowed to develop in a haphazard manner than to see that the work is properly organized at the start.

Attend the Fuel Association convention

The first of the important railroad mechanical meetings with which the convention season will open this year is that of the International Railway Fuel Association, to be held in Chicago, May 26-29. The program for this convention, which is published elsewhere in this issue, marks a unique undertaking in respect to the scope of topics to be considered and in an arrangement of subjects that serves to emphasize the relation of operating, mechanical and purchasing departments to fuel conservation. Of these departments, the mechanical is most closely identified with fuel use and can probably make the greatest contribution toward fuel conservation. The magnitude of railway fuel expenditures and opportunities for economy in fuel use are so large on all railroads that every mechanical officer should take an interest in the activities of an association devoted to railway fuel conservation.

Many mechanical officers other than those directly affiliated with fuel organizations will benefit by attending this convention. In this class there is no one man, other than the chief mechanical officer, who can individually control fuel use to a greater extent than the mechanical engineer through attention to details in design, and insistence upon standards that are essential to economy. If tests are conducted under the jurisdiction of the mechanical engineer this affords a further opportunity for promoting fuel efficiency by analytical study and judicious selection of efficient equipment. It will be noted that the convention program referred to includes a number of individual papers and reports by mechanical and test engineers on subjects relating to equipment that affects fuel use.

The first report on Diesel locomotives to be presented before a technical association in this country will be included in the proceedings of the Fuel Association together with a discussion of this development from an operating and fuel standpoint.

Incidentally, it will be observed that the practice in

regard to fully scheduling subjects and discussions followed by some of the leading technical societies will be adopted for the first time by a railway association and it is hoped that this innovation will prove successful as there is no doubt but that the proceedings at a majority of conventions could be made to cover a wider field more effectively by strict adherence to a systematic division of time between the topics to be considered.

Other classes of mechanical department employees, besides those included in the fuel organization, who would benefit particularly by attending this convention, are the roundhouse foremen, road foremen and master mechanics. It is understood that one railroad will make an especial effort to have as many roundhouse foremen as possible attend this convention knowing that these men are in a position to effect large fuel savings by the attention given to maintaining motive power and the manner in which this equipment is handled at the terminals. The International Railway Fuel Association was the first to inaugurate a committee on locomotive feed water heaters and subsequent reports of this committee have shown to what extent the efficiency of this device is influenced by the maintenance attention it receives at terminals. This is one of the subjects to be considered at the approaching convention and in addition to this, the committee will have information of interest to roundhouse foremen on the fuel cost of firing up locomotives at terminals and methods employed.

To the man in the fuel department who is identified with a mechanical organization, the work of this Association is indispensable and the program for this year's convention contains an unusual number of items of vital educational value. To the man in the operating department, the paper "How Can Railroad Management Affect Fuel Economy?" by A. R. Ayers, assistant general manager of the Nickel Plate, will perhaps be of most interest. Purchasing and stores officers responsible for placing orders for railway fuel will doubtless find much food for constructive thought in the paper by H. C. Pearce, director of purchases and stores of the Chesapeake & Ohio, "How Can Fuel Purchases Effect Economy?" The way in which mechanical officers can influence fuel economy will be discussed by John Purcell, assistant to the vice-president of the Atchison, Topeka & Santa Fe.

Turn to the International Railway Fuel Association convention program presented elsewhere in this issue and study it carefully. You will probably decide that in the interests of your road and your own mental improvement, you cannot afford *not* to attend this carefully planned, constructive and instructive convention. The opportunity to study at first hand the many fuel saving devices and equipment to be shown at the accompanying exhibition will alone be worth the cost of the trip to Chicago.

New Books

Technical Mechanics, Statics, Kinematics, and Kinetics. *By Edward R. Maurer, Professor of Mechanics, and Raymond J. Roark, Assistant Professor of Mechanics, University of Wisconsin. 364 Pages, 6 in. by 9¼ in., with Illustrations and Diagrams. Price $3.50 Net. Published by John Wiley & Sons, Inc., New York.*

Written primarily as a text book for engineering students, the authors have succeeded in handling what is generally conceded to be a subject requiring close application on the part of the reader in an interesting manner. Considerable pains have been taken in distinguishing the difference between theoretical and applied mechanics. The former is divided into statics, which treats of the relations between forces that act on bodies at rest; kinematics, which treats of motion, or the manner in which things move without regard to the cause of their motion; and kinetics, which treats of the effect of forces in producing or modifying motion. The explanations of the various factors entering into the body of exact laws and principles, comprising theoretical mechanics, that have been mathematically deduced from certain fundamental facts are unusually clear and are well illustrated with numerous diagrams, based largely on practical applications. The utilization of the various laws and principles of theoretical mechanics in the solving of practical problems in applied mechanics, is explained by problem or illustration in each case. The problems and illustrations have evidently been selected from such as should already be known to the student through past experience, though probably in a more general and qualitative, rather than in a precise and formal way.

The book is divided into 14 chapters, with two appendices and a section devoted to problems. The first seven chapters are devoted to the general subject of statics, which discusses the subjects of forces and force systems, composition and reduction of forces, forces in equilibrium, simple structures, friction, center of gravity; centroids, and suspended cables. The subject of kinematics is divided into two chapters on the motion of a point and the motion of a rigid body. The last chapter in the section includes a discussion of relative motion. Chapters 10 to 14 inclusive are placed under the general head of kinetics, and are divided under the following sub-heads, i.e.; fundamental facts; kinetics of a particle, kinetics of a body, work, power, energy, momentum and impulse, and the dimensional motion of a rigid body. Appendix A is a discussion of the theory of dimension of units and Appendix B is on the moment of inertia of wheels.

What Our Readers Think

Further comment on floating bushings

Peru, Ind.

To the Editor:

In your April issue appeared a letter from S. J. Stark, general roundhouse foreman, International-Great Northern, San Antonio, Tex., regarding the advantages of the floating bushing. The Federal inspection of locomotives at the present time is quite exacting and is becoming more so each year, and there are times when it is a struggle to get power when it is badly needed. The brasses in solid rods are held in position by a press fit and keeper bolts. This has been the practice for about 40 years, about the length of time that solid rods became universal in the United States.

With the modern Mikado type locomotive, it takes about 24 man-hours to apply a set of rod bushings. The brass alone, not counting the labor for machine work, costs about $150. If the keeper bolts are lost, the bushing will move in the rod and this usually results in a damaged pin or a cut bushing, because the lubrication is cut off from the pin. If the rod moves as much as ¼ in. on the brass, it constitutes a Federal defect and I might mention that no keeper bolt ever held a bushing in place if the bushing was loose in the rod.

We have a bearing on the Wabash that can be applied to a set of rods on a Mikado type locomotive in two hours without removing the rods from the pins. The cost of the

brass in this bearing does not exceed $50, and it is impossible to get a Federal defect from side play. The lubrication is positive at all times as provisions have been made for a reserve supply of grease in the rod. Recently a bearing was changed on one of our Pacific type locomotives in seven minutes. I know that many old shopmen will say that this is impossible, but it was done, nevertheless. This type of floating bushing has been applied to a number of Wabash locomotives and they are giving excellent results.
J. E. Allen.

The advantages of floating bushings

Brownwood, Tex.

To the Editor:

I read the letter from S. J. Stark in your April issue asking what advantages have floating bushings. I am of the opinion that the floating bushing was designed to reduce the cost of labor, reinforce the rods, eliminate the old strap and to reduce engine failures. It is claimed that 75 per cent of the engine failures are due to rod defects. Taking this into account, we also find that there is another item to consider and that is the fact that main crank pins will wear out of round as the bushing becomes worn. It is evident that all enginehouses ought to be equipped with devices for turning crank pins.

If we figure the extra cost, I don't think a very large percentage has been gained. I do not wish to condemn the floating bushing idea, but I merely am stating the facts resulting from my experience along this line of work.

I would also like to suggest to the mechanical engineers that some device should be designed to overcome this defect on pins, such as using a sliding flanged brass, split in half with heavy wedge blocks. It seems to me that such an arrangement is worth consideration.
B. G. Miller.

More mechanical supervision

Chicago.

To the Editor:

The mechanical department on our road has to a considerable extent organized along the lines suggested in the editorial, "More specialized men needed," published in the February *Railway Mechanical Engineer*, page 74. The executives in charge of many railroads, who have had ample time to analyze carefully maintenance of equipment problems, will recognize the value of a thoroughly specialized organization composed of men particularly selected on account of their experience, training and ability to handle a definite section of the organization which keeps railroad equipment in condition to give efficient service.

Officers in charge of railroad mechanical departments, so far as I have been able to learn, are seldom overpaid and in many instances their salaries are much lower than those accorded men holding equal or less responsible positions in other industries. The one hopeful feature for the mechanical officer, I would say, is the fact that railroad executives are of late years recognizing to a greater extent than ever before the possibilities for better and more economical service. They are providing more adequate facilities and equipment, even though progress along this line appears to be slow. Some intangible thing about railroad work is extremely fascinating, and this undoubtedly answers the question why railroad companies are able to hold competent men as they do when attractive offers come from other industries.

The difficulty in retaining the right caliber of men will doubtless force a change in the general aspect of the situation as experienced in the past, and it may be that the modification in viewpoint mentioned will carry with it a demand for a different type of mechanical officer and remuneration commensurate with the ability to obtain greater real results.
Superintendent of Motive Power.

Bronzing driving boxes

A question

Topeka, Kansas.

To the Editor:

In this shop we occasionally have difficulty in getting the brass liners on the shoe and wedge faces of driving boxes to lay down tight against the box. They are cast on, the box receiving two crosswise dovetail slots on the planer before it is sent to the brass foundry. In the foundry the box is not heated nor tinned but the brass is poured on the box cold. I think tinning should be considered only as a last resort as it would be quite expensive to tin all the boxes before casting on the liners. We find the brass lays down a little better on a new box than it does on an old, greasy one. Possibly the experience of some of your readers would be of assistance to me in the solution of this problem.
A Foreman.

The answer

Portsmouth, Ohio.

To the Editor:

In reply to an inquiry from one of your readers relating to bronzing the shoe and wedge faces of the driving boxes, if he will dovetail the driving boxes as described in an article on driving box work by the writer, which appeared in the September, 1924, *Railway Mechanical Engineer*, instead of crossing the dovetail grooves he will not only get better results but will be able to do the job much more quickly. Less than two per cent of our brass liners work loose on driving boxes.

In doing this work, the old bronze is stripped off the driving boxes and the grooves and anchor holes are cleaned of all pieces of the old bronze. The boxes are then sent to the bronze shop, where they are heated with a special torch using kerosene or crude oil, heating both sides of the boxes at one operation. This burner or heater is made of one 2-in. pipe drilled with 1/32-in. holes 4 in. apart, much the same as a tire heater would be made except that it is made to fit the boxes. It is not necessary to get the boxes very hot. After they are heated, the bronzing jig shown in the above mentioned article is placed on the box and the bronze poured on one side and then the other side. The jig is then removed and the box allowed to cool gradually.

We find that it is not good practice to put this bronze on too thin. Not less than ½ in. of bronze should be applied to a box, ⅛ in. of this for finishing, leaving about ⅜ in. of bronze after the boxes are machined. Several anchor holes should be drilled in each side of the box in addition to the dovetail grooves. You will note that the sketch referred to shows two dovetail grooves tapering together at the top; that is, the grooves are much closer at the top of the boxes than at the bottom. This also has a tendency to keep the liners tight should they show any signs of getting loose.

If these instructions are followed, I am sure there will be an improvement in the application of the bronze liners to the shoe and wedge faces of driving boxes.
J. H. Hahn,
Machine shop foreman, Norfolk & Western.

Long locomotive runs on the C. B. & Q.

Greatest economies are made in fuel and enginehouse expense—Savings exceed nine thousand dollars per month

PASSENGER locomotives of the Chicago, Burlington & Quincy were run through from Chicago to Burlington, Iowa, as early as 1911. However, the first regular long engine run on this road was put into effect in freight service between Alliance and Ravenna, Neb., in December, 1920; a passenger run between Wymore and McCook, Neb., was inaugurated in March, 1922; and in May, 1923, the first Burlington locomotive hauled train No. 2 from Denver, Colo., past three intermediate terminals to Lincoln, Neb., a distance of 485 miles and one of the longer coal-burning locomotive runs now regularly made.

In the past two years long engine runs have been extended quite generally over the Burlington System, giving the road an extensive experience which, under varying conditions, has demonstrated the value of this method of securing greater and more economical service from its motive power. On the system as a whole, the monthly and yearly savings and the number of locomotives released for other service are as follows:

System savings, freight and passenger service, due to long runs

	Monthly saving	Yearly saving	Engine released for other service
Lines East	$5,889	$70,668	17
Lines West	3,537	42,444	13
Total	**$9,426**	**$113,112**	**30**

These savings have been made possible by the co-operation of all departments, and also to some extent, from a mechanical point of view, by the substitution of Hulson grates for the common finger grates formerly used. With certain of the bituminous mine-run coals burned on the Burlington, 200 miles has been about the practical limit which a locomotive equipped with finger grates could run, owing to the accumulation of excessive quantities of clinker and ash. Tests have shown that with the new grates and the exercise of reasonable care on the part of firemen, these conditions are prevented and fires can be kept well beyond the mileage limit established by other considerations.

Experience on the Burlington indicates that the extension of locomotive runs over two or more divisions has practically no bearing on the cost of repairs per mile, but that real economies are to be found in the more intensive use of locomotives, the saving of enginehouse expense at intermediate terminals and in fuel economy. Moreover, the release of certain engines has permitted a reassignment of motive power to runs where it can give a more efficient performance. For example, quite a number of engines designed primarily for freight service were used on passenger trains until the inauguration of the long runs enabled them to be released.

Principal dimensions of Burlington engines used in long runs

	0-1-A	S-1	S-2	S-3	B-1
Wheel arrangement	2-8-2	4-6-2	4-6-2	4-6-2	4-8-2
Tractive force	52,300 lb.	37,200 lb.	37,200 lb.	42,200 lb.	52,750 lb.
Grate area	58.8 sq. ft.	54.2 sq. ft.	54.2 sq. ft.	58.7 sq. ft.	78.0 sq. ft.
Total square feet heating surface	4,145 sq. ft.	3,699 sq. ft.	3,680 sq. ft.	4,115 sq. ft.	5,629.7 sq. ft.
Weight on drivers	214,550 lb.	150,000 lb.	153,100 lb.	171,300 lb.	235,500 lb.
Weight of engine	272,300 lb.	228,000 lb.	236,100 lb.	269,200 lb.	350,000 lb.
Total weight engine and tender	467,300 lb.	376,200 lb.	396,400 lb.	432,740 lb.	555,450 lb.
Cylinders	27 in. by 30 in.	22 in. by 28 in. and 25 in. by 28 in.	22 in. by 28 in. and 25 in. by 28 in.	27 in. by 28 in.	27 in. by 30 in.

All of the long engine runs, both passenger and freight, now being made on the Burlington are shown in Tables I and III, the savings being given in Tables II and IV. The locations of the various terminals are indicated in the map which also shows how generally the long runs are distributed over the entire Burlington system.

There are six trains (Nos. 47, 48, 49, 50, 51 and 52) between Chicago and St. Paul, Minn., making a total of 2,586 miles a day. Formerly these trains were handled by nine locomotives which number has now been reduced to seven. This has saved two locomotives and increased the average miles per day for these locomotives from 276 to 369, or 93 miles.

Between Burlington, Iowa, and Lincoln, Neb., there are six trains (Nos. 2, 3, 5, 6, 9 and 12) making a daily mileage of 2,070. Formerly handled with thirteen locomotives, these trains are now handled with nine locomotives, releasing four for other service. The average daily mileage per locomotive has increased 71.

On the Nebraska district 10 trains (Nos. 3, 5, 9, 15, 17, 2, 6, 14 and 16) make a daily mileage of 4,189. Prior to extended runs, 25 locomotives were used in this service, making the average daily mileage per locomotive 167. Under the new system 18 locomotives are being used, increasing the average daily mileage per locomotive to 233, or an increase of 66. These are but a few selected long runs. On the road as a whole the inauguration of long engine runs has increased the average daily mileage of the passenger locomotives involved, by 72 miles, as shown in Table V, resulting in the release of 23 locomotives for other service. The total daily train mileage made is 14,607.

Reference to Tables I and III will indicate the preponderance of passenger over freight locomotive runs. Long runs are being inaugurated in freight service, however, as fast as practicable.

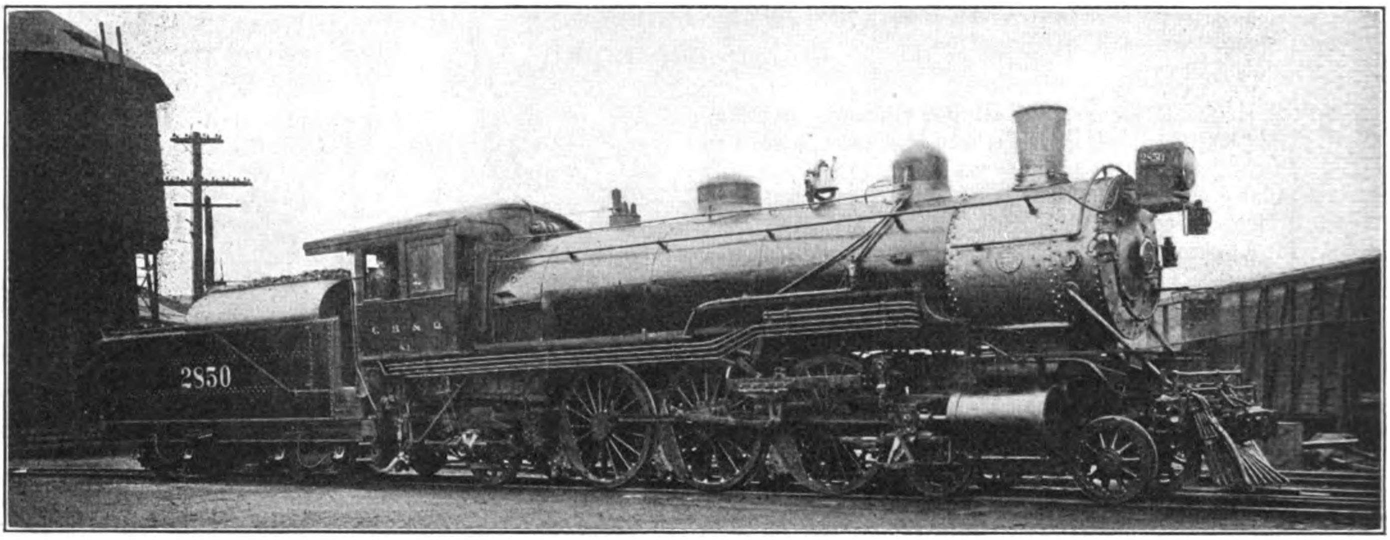
In connection with the Lincoln-Denver runs it will be noted that eastbound there is no engine change but, owing to adverse grades westbound and the consequent heavy working of the locomotives, considerable more attention is required at McCook, Neb., than could be given without undue delay to the trains. As a result, train Nos. 3 and 9 change locomotives at McCook.

More or less the same conditions exist with regard to the Denver, Colo., to Billings, Mont., runs. All locomotives are changed at Casper, Wyo. Northbound they also change at Greybull, but southbound they run through from Billings to Casper.

Formerly the Colorado & Southern used one engine between Denver and Cheyenne on trains 29 and 30—one engine between Cheyenne and Casper on the same trains

and the Chicago, Burlington & Quincy furnished one engine between Casper and Cheyenne, making a total of three engines between Denver and Casper. The engine runs are now between Casper and Denver. One C. B. & Q. engine is being used instead of two Colorado & Southern service, being used to the best advantage to fit the tonnage east and west of Bonneville.

In the freight pool between Alliance and Ravenna, Neb., twenty 0-1-A locomotives were formerly used. Since running through the terminal at Seneca without change,



Engine 2850 equipped with Hulson grates made 1,492 miles in 121 hours with a single fire

engines to equalize the mileage, since 240 of the 339 miles are on the Colorado & Southern.

Freight engines are run through from Casper and Greybull as business requires. A mixed class of power is in only eighteen locomotives are required, thus saving two 0-1-A locomotives.

From a consideration of Tables II and IV it will be evident that on both the east and west lines of the Burling-

Table I—Long engine runs on the C. B. & Q. (Lines east)

Train Nos.	Present assignment: Present terminal: Initial	Final	Class of loco.	No. of miles	Former Assignment: Former Terminal: Initial	Final	Class of loco.	No. of miles
				(Chicago-Savanna-St. Paul.)				
49-51	Chicago	St. Paul	S-1-A	431	Chicago	Savanna	S-1-A	145
					Savanna	St. Paul	S-2-A	286
50-52	St. Paul	Chicago	S-2-A	431	St. Paul	Savanna	S-2-A	286
					Savanna	Chicago	S-1-A	145
47	Chicago	Minneapolis	S-1-A	442	Chicago	Savanna	S-1-A	145
					Savanna	Minneapolis	S-1-A	297
48	Minneapolis	Chicago	S-2-A	442	Minneapolis	Savanna	S-2	297
					Savanna	Chicago	S-1-A	145
				(St. Louis-Beardstown-Galesburg.)				
47-51	St. Louis	Galesburg	P-2	208	St. Louis	Beardstown	P-2	114
					Beardstown	Galesburg	K-2	94
48-52	Galesburg	St. Louis	P-2	208	Galesburg	Beardstown	K-10	94
					Beardstown	St. Louis	P-2	114
				(Galesburg-Brookfield-Kansas City.)				
55	Galesburg	Kansas City	S-2	327	Galesburg	Brookfield	S-2	204
					Brookfield	Kansas City		123
56	Kansas City	Galesburg	S-2	327	Kansas City	Brookfield		123
					Brookfield	Galesburg	S-2	204
				(Burlington-Creston-Lincoln.)				
3-5-9	Burlington	Lincoln	S-3	345	Burlington	Creston	S-3	187
					Creston	Lincoln	S-3	158
2-6-12	Lincoln	Burlington	S-3	345	Lincoln	Creston	S-3	158
					Creston	Burlington	S-3	187
25-7	Chicago	Creston	S-1	394	Chicago	Burlington		206
					Burlington	Creston	R-5	188
4-30	Creston	Chicago	S-1	394	Creston	Burlington	R-5	188
					Burlington	Chicago		206
77-79 (Frt.)	Galesburg	Creston	O-1-A	230	Galesburg	Ottumwa	O-2	117
					Ottumwa	Creston		113
70-74 (Frt.)	Creston	Galesburg	O-1-A	230	Creston	Ottumwa	O-2	113
					Ottumwa	Galesburg		117
				(St. Joseph-Brookfield-Hannibal.)				
14-16	St. Joseph	Hannibal	S-2	206	St. Joseph	Brookfield	S-2	102
					Brookfield	Hannibal	S-1	104
15-17	Hannibal	St. Joseph	S-2	206	Hannibal	Brookfield	S-1	104
					Brookfield	St. Joseph	S-2	102
				(Omaha-St. Joseph-Kansas City.)				
20-22	Omaha	Kansas City	P-5	197	Omaha	St. Joseph	P-1	133
					St. Joseph	Kansas City	S-2	64
21-23	Kansas City	Omaha	S-2	197	Kansas City	St. Joseph	S-2	64
					St. Joseph	Omaha	S-2	133
72 (Frt.)	Omaha	Kansas City	O-1-A	197	Omaha	St. Joseph	R-4	133
					St. Joseph	Kansas City	R-S	64
75 (Frt.)	Kansas City	Omaha	O-1-A	197	Kansas City	St. Joseph	R-5	64
					St. Joseph	Omaha	R-4	133

ton the savings in enginehouse expense at intermediate terminals has exceeded the fuel savings. To a certain extent increased attention at final terminals, more careful inspection at stations en route, the disposition of ashes when ashpans are cleaned away from regular terminals and other conditions necessitate additional expense. At many intermediate terminals, however, the operations of inspecting and caring for locomotives have been greatly reduced in magnitude so that a net saving for the system is obtained as shown in the tables. The work saved at intermediate terminals consists of inspection, cleaning, knocking and rebuilding fires, washing boilers and normal repair work by enginehouse maintenance forces.

Enginehouse and fuel savings

The fuel savings shown in the tables are conservative, being based quite largely on the number of fires saved and not taking into account the standby losses occasioned when locomotives have their fires knocked at intermediate terminals and are later held under steam waiting for call. Every time a locomotive goes to a terminal there is more or less unavoidable waste of coal in keeping up steam pressure and direct loss to the ash pit. Before leaving, the fireman almost always throws on a few shovelfuls of coal to make sure that there will be steam enough to move the locomotive over the ash pit and, in heading, the hostler usually throws on a little more fuel for the same reason. All of this coal, together with other unburned coal in the firebox, goes into the ash pit when the fire is knocked. This loss is in direct proportion to the frequency with which the locomotives have to pass over the ash pit for cleaning.

More coal is saved in winter than in the summer months owing to increased radiation losses and the necessity of

Table II.—Summary of savings effected by long runs (Lines east)

Passenger Service

Train Numbers	Terminals Between	Force Reductions	Fuel Savings	Total Approx. Savings Per Mo.	Engines Released For Other Service
51-52-47-48-49-50	Chicago & St. Paul	$1,950	$450	$2,400	2-Pacific Type C. B. & Q. Class S-2.
47-48-51-52	St. Louis & Galesburg	345	330	675	3-10 Wheel Type, C. B. & Q. Cl. K-10
55-56	Kansas City & Galesburg	296 (X)	165	461	1-Pacific, C. B. & Q., Class S-2
3-59-2-6-12	Burlington & Lincoln				
4-30	Chicago & Creston	550	495	1,045	4-Pacific, C. B. & Q., Class S-3
14-15-16-17	Hannibal & St. Joseph	...*	330	330	1-Pacific, C. B. & Q., Class S-2
20-21-22-23	Kansas City & Omaha	150	330	480	1-Pacific, C. B. & Q., Class S-2
Total		$3,291	$2,100	$5,391	12 Engines
	Freight Service				
72-75	Kansas City & Omaha	None	178	178	1-Prairie, Class R-5
70-74-77-79	Creston & Galesburg	None	320	320	4-Mikado, Class O-2
Total		...	$498	$498	5 Engines

Grand Total Savings (Lines East)—$5,889 per Month.
Total Engines Released (Lines East)—17 Engines.

*Payroll Saving Included in (X)

Table III.—Long engine runs on the C. B. & Q. (Lines west)

Train Nos.	Present assignment: Present Terminal: Initial	Final	Class of loco.	No. of miles	Former Assignment: Former Terminal: Initial	Final	Class of loco.	No. of miles
				(Lincoln-McCook-Denver.)				
3-5-9	Lincoln	McCook	B-1	230	Lincoln	Hastings	S-2	98
					Hastings	McCook		132
3-9	McCook	Denver	B-1	255	McCook	Akron	S-3	143
					Akron	Denver		112
6-2	Denver	Lincoln	B-1	485	Denver	Akron	S-1	112
					Akron	McCook		143
			S-1	...	McCook	Hastings	S-2	132
					Hastings	Lincoln		98
22	McCook	Lincoln	S-1	230	McCook	Hastings	S-3	132
					Hastings	Lincoln	S-1	98
				(Wymore-McCook-Denver.)				
15-17	Wymore	McCook	S-2	228	Wymore	Red Cloud	S-1	108
					Red Cloud	McCook	S-1	120
15-17	McCook	Denver	S-1-A	255	McCook	Akron	S-1	143
					Akron	Denver	S-1	112
14-16	Denver	McCook	S-1	255	Denver	Akron	S-1	112
					Akron	McCook	S-1	143
14-16	McCook	Wymore	S-1	228	McCook	Red Cloud	S-1	120
					Red Cloud	Wymore	S-2	108
				(Alliance-Sheridan.)				
41-43	Alliance	Sheridan	S-3	333	Alliance	Edgemont	S-3	111
					Edgemont	Sheridan	...	222
42-44	Sheridan	Alliance	S-3	333	Sheridan	Edgemont	S-3	222
					Edgemont	Alliance	...	111
				(Denver-Casper-Billings.)				
29	Denver	Casper	S-3	339	Denver	Cheyenne	S-3	120
					Cheyenne	Casper		119
29	Casper	Greybull	S-2	202	Casper	Greybull	S-2	202
29	Greybull	Billings	S-2	127	Greybull	Billings		127
30	Billings	Casper	S-1	329	Billings	Greybull	S-1	202
					Greybull	Casper		127
30	Casper	Denver	S-3	...	Casper	Cheyenne	S-3	...
					Cheyenne	Denver		...
				(Alliance-Seneca-Ravenna.)				
Pool† (Frt.)	Alliance	Ravenna	O-1-A	238	Alliance	Seneca	O-1-A	108
					Seneca	Ravenna		130

†There were 20 O-1-A engines in this pool running between Alliance and Seneca and Seneca and Ravenna. Since running these engines through from Alliance to Ravenna and return the pool has been reduced to 18 O-1-A engines.

keeping locomotives, not in the enginehouses, fired up to prevent freezing.

Maintenance standards kept high—Lubrication

A high standard of maintenance and consequently high mileage per engine failure is responsible in no small measure for the success of the Burlington in inaugurating long engine runs. The present excellent condition of Burlington locomotives engaged in running over two or more divisions has been brought about by tightening up in the work of inspection, and making minor repairs promptly before defects have time to develop and possibly cause failures. Another contributing factor is the general improvement program carried out at the various shops on the system whereby locomotive parts such as frames which have shown themselves to be weak and a frequent source of failure have been strengthened by putting in heavier sections. Old type cylinders subject to breakage between the valve chambers and frames have been replaced by improved modern designs.

The question of proper lubrication is important to the success of long engine runs and the way in which this is handled on the Burlington may be illustrated by the practice on locomotives running between Chicago and St. Paul, Minn. Three-pint lubricators are used on most of the locomotives in question and when they leave the Chicago terminal the lubricator is full and the engineman has 4½ pints in the tallow pot in addition. At Savanna, Ill., a service man meets the locomotive at the station and fills the lubricator, also the side and main rod grease cups. The same operation is repeated at Grand Crossing, Wis. Six pints of black or engine oil is provided. On the run from Chicago to Creston, Iowa, the lubricators are refilled at Burlington, Iowa. On this run the engineman starts out with five pints of valve oil in addition to the three pints in the lubricator. He is furnished with eight pints of black or engine oil.

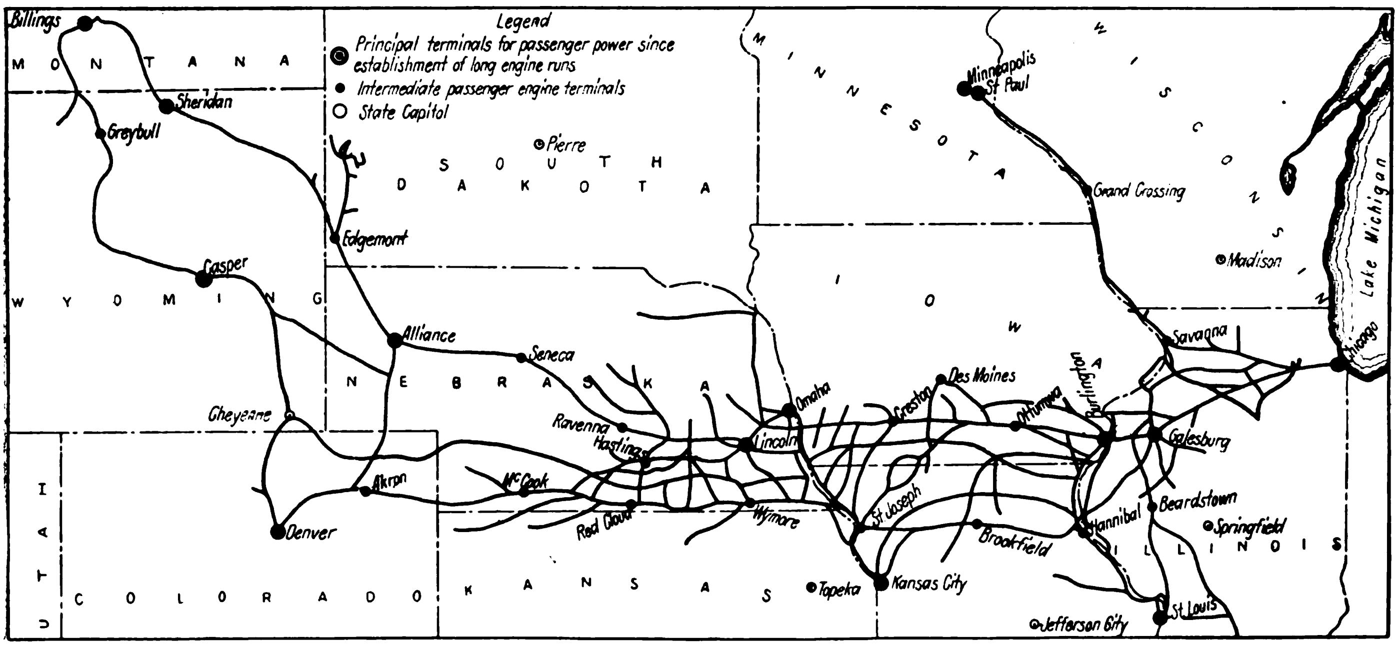
Table IV.—Summary of savings effected by long runs (Lines west)

Train Numbers	Terminals Between	Force Reductions	Fuel Savings	Total Approx. Savings Per Mo.	Engines Released For Other Service
	Passenger Service.				
3-5-9-15-17 2-6-14-16-22	Lincoln & Denver Wymore & Denver	$706	$367	$1,073	7-Pacific type, C. B. & Q., Class S-2
29-30	Denver & Casper Casper & Billings	120	235	355	1-Pacific type, C. B. & Q., Class S-1
41-42-43-44	Alliance & Sheridan	440	270	710	3-1 Pacific type, C. B. & Q., Cl. S-2 2 Mountain type, C. B. & Q., Cl. B-1
Total		$1,266	$872	$2,138	11 Engines
	Freight Service.				
Pool	Alliance & Ravenna	$1,276	$123	$1,399	2-Mikado type, C. B. & Q., Cl. O-1-A
Total		$1,276	$123	$1,399	2 Engines

Grand Total Savings (Lines West)—$3,537 per Month.
Total Engines Released (Lines West)—13 Engines.

Hulson grates aid long runs; now standard on system

Approximately 40 per cent of the locomotives used in long runs on the Burlington are equipped with Hulson grates which are now the system standard and which are being applied to the balance of the power as rapidly as practicable. Both trial and service tests of these grates showed that they aid materially in enabling coal-burning locomotives to run past intermediate terminals where the locomotives formerly stopped to receive enginehouse attention, including new fires. On account of the rocking feature of these grates experience showed that the fires were not broken up in shaking, and in fact it was possible to remove just the right amount of ash from the bottom of the grates by a light shaking, thus keeping the fires at the proper thickness. This feature, in conjunction with the 55 per cent air opening, practically prevented clinker



Map of the Burlington System showing the principal terminals handling passenger power since long runs have been established

formation with any of the coals burned. The grates proved popular with the crews owing to the ease of shaking which also encouraged firemen to shake their grates frequently and to keep the fires in a good clean condition.

The possibilities in the way of long fire life were indicated by two tests conducted in the latter part of 1923, in one of which Engine 2850 made 1,492 miles before the fire was knocked, the life of this fire being 121 hours. In the other case Engine 2855 made 2,645 miles with a single fire, the life of which was 183 hours. The following is a detailed report of the performance of these two engines during the periods referred to:

Life of fire on engine 2850—Equipped with Hulson grates

Engine out of shops, West Burlington, Iowa	October 17
Fired up at Burlington enginehouse, at 10 a. m.	October 18
Trial run to New London and return (total 50 miles)	October 19
(Fire not cleaned)	
Called for No. 4 at 11 p. m.	October 19
Arrived at Chicago at 6:37 a. m.	October 20
(Ash pan cleaned; fire not cleaned)	
Called for No. 11 at 11 a. m.	October 20
Arrived at Burlington at 6:40 p. m.	October 20
(Ash pan cleaned; fire not cleaned)	
Called for No. 4 at 11 p. m.	October 20
Arrived at Chicago 6:37 a. m.	October 21
(Ash pan cleaned; fire not cleaned)	
Called for No. 11 at 11 a. m.	October 21
Arrived at Burlington at 6:40 p. m.	October 21
(Ash pan cleaned; fire not cleaned)	
Called for No. 4 at 11 p. m.	October 21
Arrived at Chicago at 6:37 a. m.	October 22
(Ash pan cleaned; fire not cleaned)	
Called for No. 11 at 11 a. m.	October 22
Arrived at Burlington at 6:40 p. m.	October 22
(Ash pan cleaned; fire not cleaned)	
Called for No. 4 at 11 p. m.	October 22
Arrived at Chicago at 6:37 a. m.	October 23
Called for No. 11 at 11 a. m.	October 23
On despatcher's order, held for No. 49	October 23
Fire knocked for boiler washout	October 23
Engine on and off clinker pit in 4 min.	
Total running time	57 hr., 40 min.
Total enginehouse time	63 hr., 20 min.
Total life of fire	121 hr.
Total mileage	1,492

Life of fire on engine 2855—Equipped with Hulson grates

Called for No. 71, Burlington, Iowa, to Ottumwa, at 5:15 p. m.	November 20
(74 miles, 25 cars, 1,200 tons)	
Arrived at Ottumwa, at 8:45 p. m.	November 20
(Ash pan cleaned; fire not cleaned)	
Called for No. 76, at 10:45 a. m.	November 21
(74 miles, 31 cars, 960 tons)	
Arrived at Burlington at 3:10 p. m.	November 21
(Ash pan cleaned; fire not cleaned)	
Called for No. 7, Burlington, Iowa, to Creston, at 6:55 a. m.	November 22
(188 miles, 6 cars of mail)	
Arrived at Creston at 11:30 a. m.	November 22
(Ash pan cleaned; fire not cleaned)	
Called for No. 4 at 2:40 p. m.	November 22
(188 miles, 9 passenger cars)	
Arrived at Burlington at 9:30 p. m.	November 22
(Ash pan cleaned; fire not cleaned)	
Called for No. 7 at 6:55 a. m.	November 23
Arrived at Creston at 11:30 a. m.	November 23
(Ash pan cleaned; fire not cleaned)	
Called for No. 4 at 2:40 p. m.	November 23
Arrived at Burlington at 9:30 p. m.	November 23
(Ash pan cleaned; fire not cleaned)	
Called for No. 7 at 6:55 a. m.	November 24
Arrived at Creston at 11:30 a. m.	November 24
(Ash pan cleaned; fire not cleaned)	
Called for No. 4 at 2:40 p. m.	November 24
Arrived at Burlington at 9:30 p. m.	November 24
(Ash pan cleaned; fire not cleaned)	
Called for No. 7 at 6:55 a. m.	November 25
Arrived at Creston at 11:30 a. m.	November 25
(Ash pan cleaned; fire not cleaned)	
Called for No. 4 at 2:40 p. m.	November 25
Arrived at Burlington at 9:30 p. m.	November 25
(Ash pan cleaned; fire not cleaned)	
Called for No. 18, Burlington to Chicago, at 9:10 a. m.	November 26
Arrived at Chicago at 2:40 p. m.	November 26
Called for No. 15, Chicago to Creston, at 9 p. m.	November 26
Arrived at Creston at 5:40 a. m.	November 27
(Ash pan cleaned; fire not cleaned)	
Called for No. 4 at 2:40 p. m.	November 27
Arrived at Burlington at 9:30 p. m.	November 27
(Ash pan cleaned; fire not cleaned)	
Called for No. 12 at 3:05 a. m.	November 28
Arrived at Chicago at 9 a. m.	November 28
Engine held for washout	November 28
Fire was knocked in 10 min.	November 28
Total running time	80 hr. and 30 min.
Total enginehouse time	102 hr., 30 min.
Total life of fire	183 hr., 45 min.
Total mileage	2,645

In the test of Engine 2855, it performed a variety of service, handling passenger, mail and freight trains between Chicago, Burlington and Creston, Iowa. The fire was finally knocked after 2,645 miles to permit a thorough boiler washout. The life of the fire was 183 hr., 45 min., and it was the consensus of opinion that it could have continued indefinitely, burning the average run of coal on these divisions. There was a saving of the knocking and building of 12 fires. Successful test runs of a similar character were made on the Brookfield division where the water is bad and locomotives must be held for a washout every 400 miles.

Table V.—Increase in daily mileage of passenger locomotives

Division	Train numbers	Daily train miles	No. of engines now used	No. of engines formerly used
Alliance-Sheridan	41-42-43-44	1,332	6	8
Denver-Billings	29-30	1,344	5	7
St. Louis-Galesburg	47-48-51-52	832	4	7
Nebraska District	(3-5-9-2-6-22) (15-17-14-16)	4,189	18	25
Galesburg-Kansas City	55-56	650	2	3
Hannibal-St. Joseph	14-15-16-17	824	3	4
Omaha-Kansas City	20-21-22-23	780	4	5
Chicago-St. Paul	47-48-49-50-51-52	2,586	7	9
Lincoln-Burlington	2-3-5-6-9-12	2,070	9	13
		14,607	58	81

Former average daily locomotive mileage	180
Present average daily locomotive mileage	252
Miles per day increase	72
Percentage increase	40
Locomotives released to other service	23

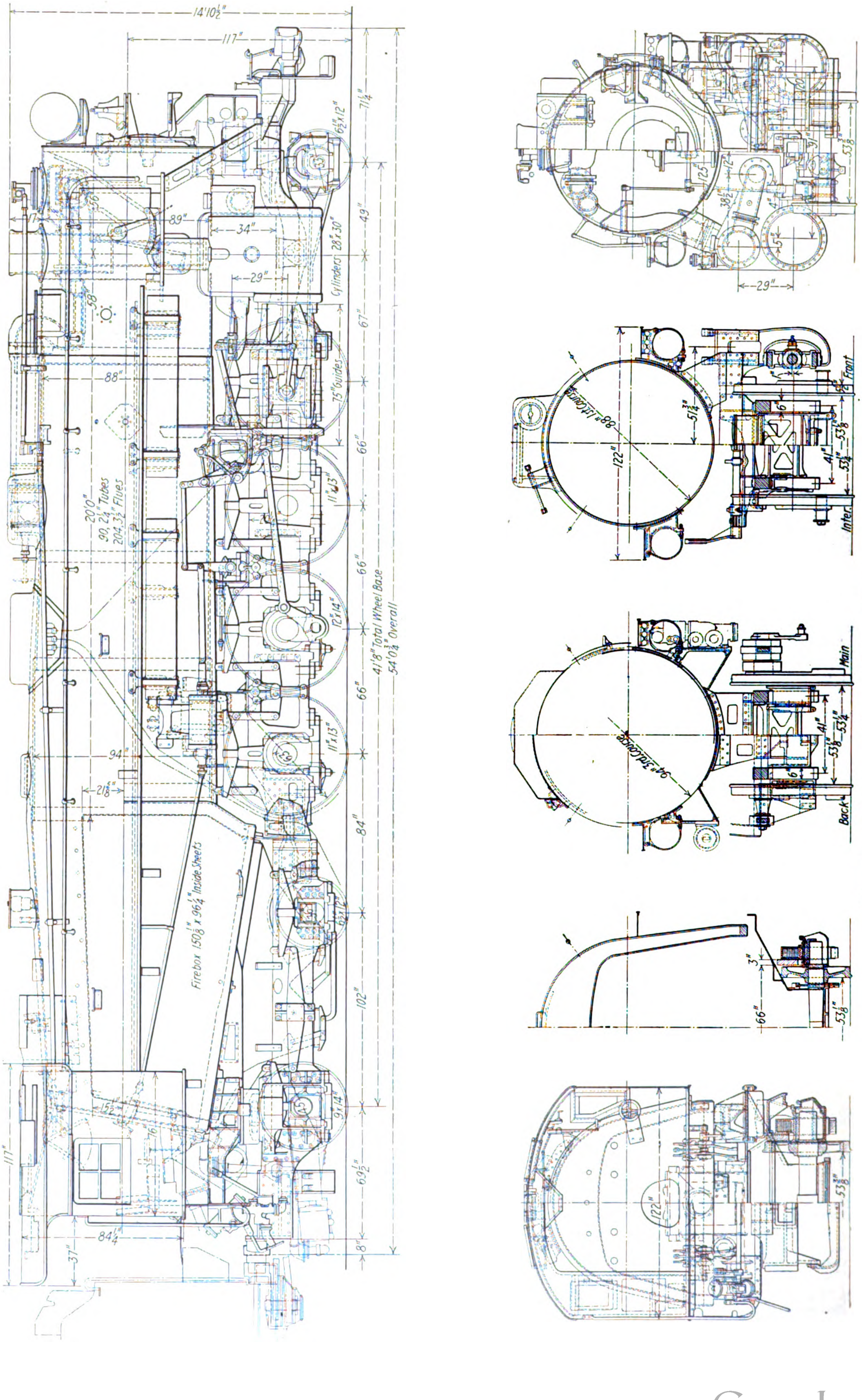
From an examination of this record it will be evident that engine 2850 made seven trips in regular passenger service between Chicago and Burlington, Iowa, with a single fire, and then the fire was knocked because the locomotive was scheduled to take No. 49 into a bad water district making it necessary to wash out the boiler. In connection with the ratio of running to enginehouse time, it is interesting to note that Engine 2850 was in service 47.5 per cent of the time, which is considerably better than the national average of 33⅓ per cent.

No firing tool was used on Engine 2850 during the runs, the fire being kept clean by shaking the grates lightly. On arrival at a terminal the fire was shaken and enough coal added to keep it in shape while in the enginehouse. There was no formation of clinkers and the thickness of the fire at the end of the run is indicated by the fact that only four minutes were required on the cinder pit.

The grates were shaken four or five times on each trip and at no time were they difficult to shake.

The coal varied from good to dirty mine-run, from Southern Illinois. This test indicate the better combustion obtained with the 55 per cent air opening, and that the grates can be shaken lightly under a thin fire without disturbing the fire bed. The fine ash, being sifted from underneath the fire as it formed, resulted in a clean fire at practically all times.

The Legislature of Missouri has passed a bill providing that water glasses must be so placed on locomotives that both the engineman and fireman will be able to see the water level from their seats.



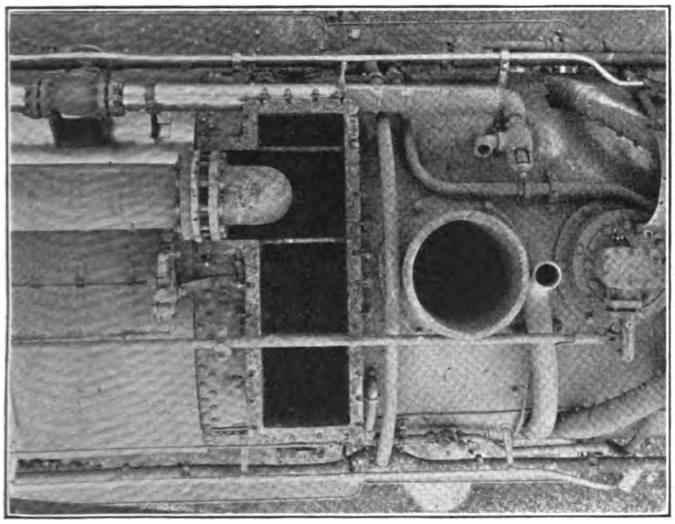
Elevation and cross sections of Lima 2-8-4 type locomotive

High power 2-8-4 type locomotive

Has 100 sq. ft. of grate, 4-wheel trailer truck and 60 per cent maximum cut-off—Tractive force with booster, 82,600 lb.

THE Lima Locomotive Works, Inc., late in January, completed a 2-8-4 type freight locomotive with 100 sq. ft. of grate area. This locomotive, which is owned by the builder, was placed in service on the Boston & Albany in February. It weighs 385,000 lb., of which 248,200 lb. is on the drivers and 101,300 lb. on the four-wheel articulated trailing truck. It carries 240 lb. boiler pressure and, with a maximum cut-off of 60 per cent, develops a tractive force of 69,400 lb. Including the booster, which drives on the rear pair of trailing wheels, the total tractive force is 82,600 lb.

The principal objectives in the design of this locomotive were the development of high horsepower capacity and improved economy in the use of fuel. It may be considered a logical step forward in carrying out the principles on which this builder has been working since the inception of the design of Locomotive 8000 which was built for the Michigan Central in 1922, and of which design over 300 have since been built for various parts of the New York Central System. A comparison of the more important dimensions and proportions of the two locomotives will serve to indicate the methods by which it is expected to obtain the increased horsepower and higher fuel economy. Such a comparison will be found in the table.

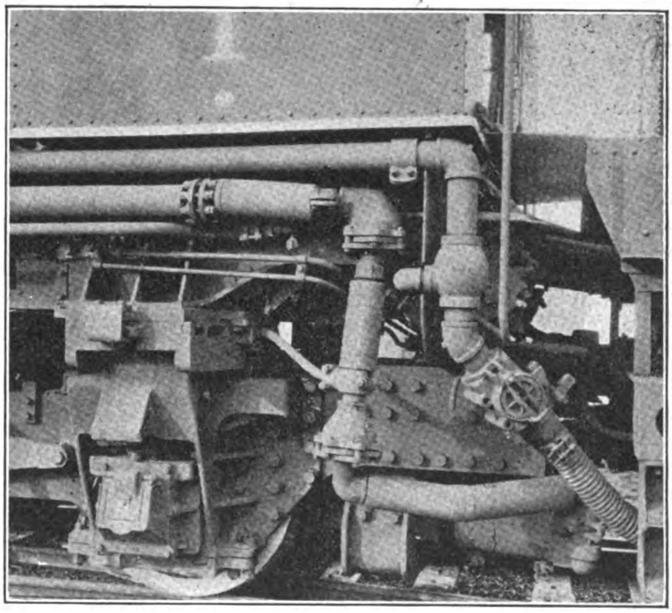


Looking down on the top of the smoke box—The superheated steam line of the turret is shown at the top of the picture

It will be seen that the cylinders are the same size on both locomotives. This suggests that an increase in tractive force was not the primary objective, although some increase has been possible because of the smoother torque curve and the resulting lower factor of adhesion which the employment of limited cut-off made possible. The outstanding difference in proportions is in the size of the grate, the new 2-8-4 locomotive having approximately 50 per cent more grate area than did the earlier Mikado. It will also be noted that the boiler is somewhat larger in other respects. The total evaporative heating surface has been increased about 12 per cent and there is an 18 per cent increase in the amount of superheating surface, resulting in an increase of combined evaporative and superheating surface of about 13½ per cent. While these figures indicate a considerable increase in capacity for heat absorption, the greatest increase in boiler capacity will undoubtedly result from the ability to release at the grate a large aggregate amount of heat at exceptionally low rates of combustion. This favors both high boiler capacity and high fuel economy.

Comparison of Locomotive A-1 and Locomotive 8000

	A-1	8000
Type	2-8-4	2-8-2
Cylinders, diameter and stroke	28 by 30	28 by 30
Cut-off in full gear	60 per cent	Full stroke
Boiler pressure	240 lb.	210 lb.
Weights in working order:		
On drivers	248,200 lb.	248,000 lb.
On front truck	35,500 lb.	29,000 lb.
On trailing truck	101,300 lb.	58,000 lb
Total engine	385,000 lb.	335,000 lb
Diameter drivers	63 in.	63 in.
Heating surfaces:		
Firebox, incl. arch tubes	337 sq. ft.	291 sq. ft.
Tubes and flues	4,773 sq. ft.	4,287 sq ft.
Total evaporative	5,110 sq. ft.	4,578 sq. ft.
Superhating	2,111 sq. ft.	1,780 sq. ft.
Comb. evaporative and superheating	7,221 sq. ft.	6,358 sq. ft.
Grate area	100 sq. ft.	66.4 sq. ft.
Net gas area through tubes and flues	1,536 sq. in.	1,348 sq. in.
Rated tractive force:		
Engine	69,400 lb.	66,700 lb.
Engine and booster	82,600 lb.	77,700 lb.
Factor of adhesion	3.58	3.72



Furnace expansion and trailer lateral motion bearings

The other principal factor in this design for the improvement of fuel economy is the employment of the limited maximum cut-off which is accompanied by an increase in boiler pressure primarily to offset the reduction in the ratio of mean effective pressure to initial pressure resulting from the limited cut-off. While the

value of the limited cut-off as an economy factor is more apparent within the speed range at which full-stroke cut-off locomotives are ordinarily operated, it has also been found that a significant reduction in water rate occurs throughout the entire speed range. For freight service, a very considerable percentage of the locomotive mileage is made in the speed range within which full-stroke locomotives operate at more than 60 per cent cut-off.

There is some tendency toward improved thermal efficiency because of the higher boiler pressure. Its principal effect, however, is to increase the tractive force over that of the full-stroke cut-off locomotive at speeds where less than 60 per cent cut-off is required. This means correspondingly increased horsepower at these speeds.

Aside from the proportions of the new locomotive, its construction embodies four important innovations in detail design.* These are the cast steel cylinders which have made possible a saving of 4,000 lb. in weight; the articulated four-wheel trailing truck which does not require rear frame extensions and has made possible a marked improvement in ash pan design; the articulated main rod which delivers its load on two outside crank pins instead of on one, and the simple port arrangement by which an unbalanced cut-off has been obtained in the two ends of the cylinders at starting, with a resulting increase in the smoothness of the starting torque curve.

Cast steel cylinders

This is not the first application of cast steel cylinders. It will be remembered that Locomotive 50,000 built in 1911 by the American Locomotive Company was equipped with cylinders of this material. The cylinders on Locomotive 50,000 called for the use of outside steam pipe connections, but the exhaust passages from the valve chamber were cored inside the body of the casting. In the case of the cylinders on the new locomotive, there are no steam passage connections from the valve chamber to the saddle proper. The only steam passages in the saddle are from the front and back faces of each half saddle inward and upward to the exhaust standpipe base. The cores for these passages are supported in the mold at each end, making the floating of the core very unlikely, and the walls of the passages are accessible should it be necessary to close a blow-hole by welding.

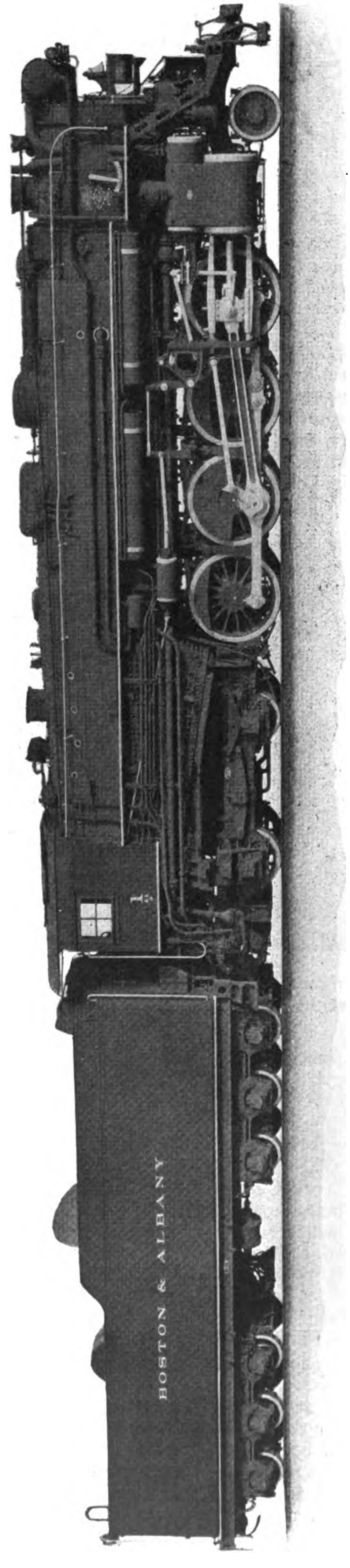
The photographs show clearly how connection is made from the valve chambers to the saddle exhaust passage by means of cast pipes which are bolted to openings in the valve chamber extension heads at one end and against the face of the saddle casting at the other. This construction leaves the designer free to distribute his metal in the connections between the saddle and the cylinder and valve chamber with one objective in mind—the strength and quality of the casting.

Before the design of the new locomotive was laid down, a cylinder and half-saddle of this design was cast, machined and pressure tested. As a result of the experience obtained from this casting, the cylinders for the new locomotive were cast with only minor changes in the pattern.

The four-wheel trailer truck

The articulated four-wheel trailing truck is a unique development in the design of the frame and the equalizer systems. This truck in effect forms a part of the main frame system, leaving no need for a rear frame extension back of the main frames. The main frames terminate just back of the rear pair of drivers. Between them is bolted a hinge casting of the Mallet type; a corresponding

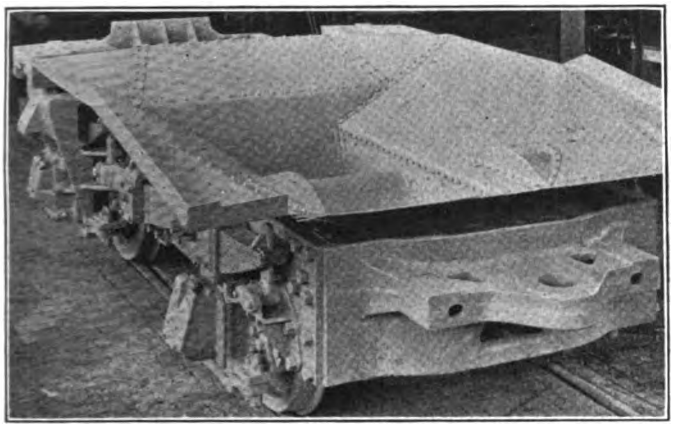
* These details and other features and combinations embodied in this locomotive are covered by patents or patents pending.



A departure from customary locomotive proportions—A grate area of 100 sq. ft. reduces the rate and improves the efficiency of combustion; a maximum cut-off of 60 per cent improves steam economy and increases horsepower output at medium and high speeds

hinge casting forms the front member of the trailer truck. The buffing and pulling stresses are thus transmitted directly through the trailing truck frames and the drawbar pocket forms a part of the rear trailer frame casting. These frames have a section of 3 in. by 17 in. where the rear frame casting is bolted between them and are 3 in. by 21 in. in section between the axles.

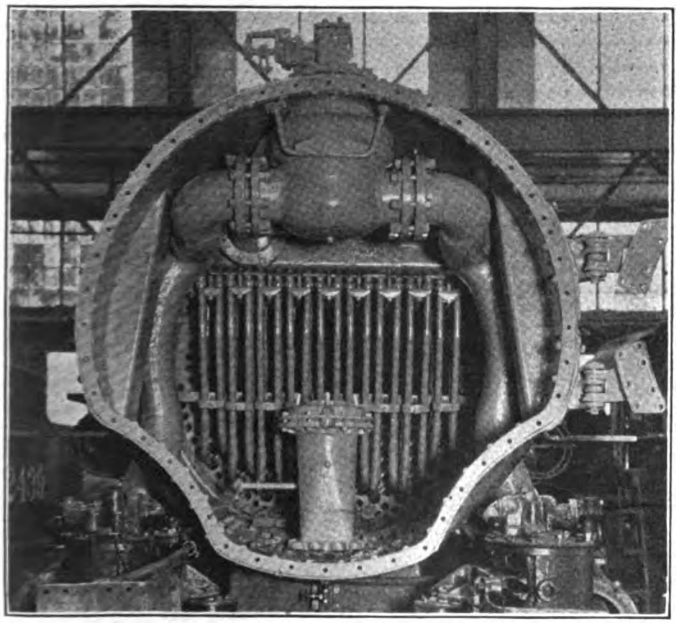
The vertical load is transmitted to the trailer truck at



The front end of the trailer truck, showing the ash pan in place

two points on each side: at the front corners of the trailer hinge casting, on the top surface of which rest extensions of the main frames, and at the rear corners of the firebox, each of which is supported on a combined expansion and self-centering lateral motion bearing. It will thus be seen that while the trailer truck is free to swing laterally about its hinge joint, its vertical alinement remains unchanged with respect to the main frames, of which, in effect, it forms a part.

The two journal boxes on each side of the trailer are

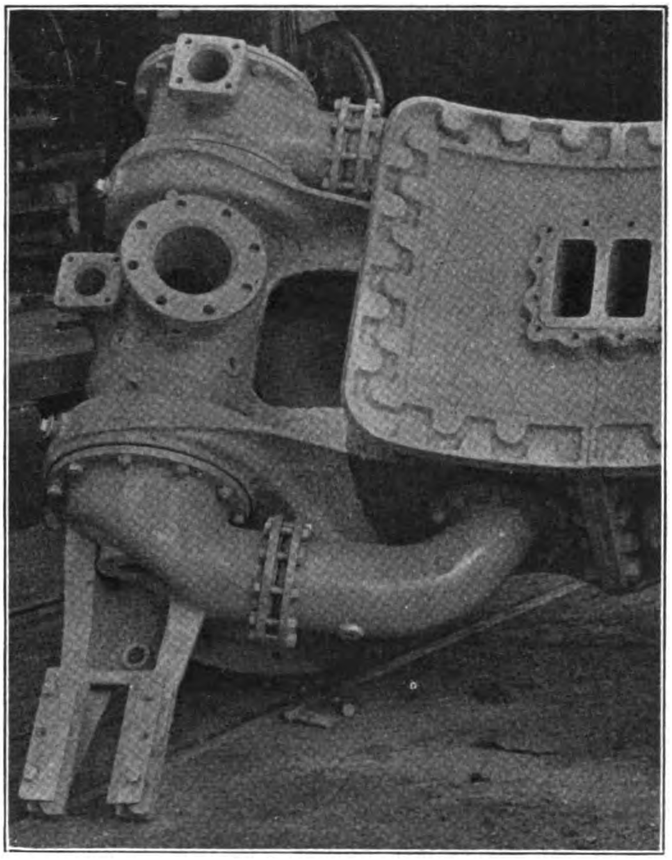


Interior of the front end during construction

equalized together, each side thus forming one point of the three-point spring suspension. The entire driving wheel base on each side of the locomotive is equalized together and the two sides are cross-equalized with the leading truck, so that the leading truck and the entire driving wheel base form the third point of the spring suspension.

One of the influences of this truck on the design of the locomotive, which, although incidental, is none the less important will be seen in the ash pan. The elimination of the rear frame extensions has removed one of the worst restrictions on securing a satisfactory slope of the ash pan side sheets and the space between the trailer axles has permitted the building of hoppers of unusually large capacity. Although the grate is unusually large, the ash pan provides but little less than one cubic foot of capacity per square foot of grate.

The ash pan, instead of being attached directly to the mud ring, is built into the trailer truck and when the trailer truck is removed from the locomotive the ash pan is removed with it. The width of the flare required to keep the ash pan under the firebox when the trailer is displaced laterally on curves also provides an unrestricted



The cast steel cylinder, showing the outside exhaust pipe connections

air opening all around between the ash pan and the mud ring.

In the absence of rear frame extensions from which the cab and a number of items of auxiliary equipment are supported, heavy cast steel cab brackets are attached to the back corners of the mud ring. Heavy lugs are cast below the back and sides of the mud ring at the corners to support these brackets, which also form the top members of the combined furnace bearers and trailer truck lateral motion bearings.

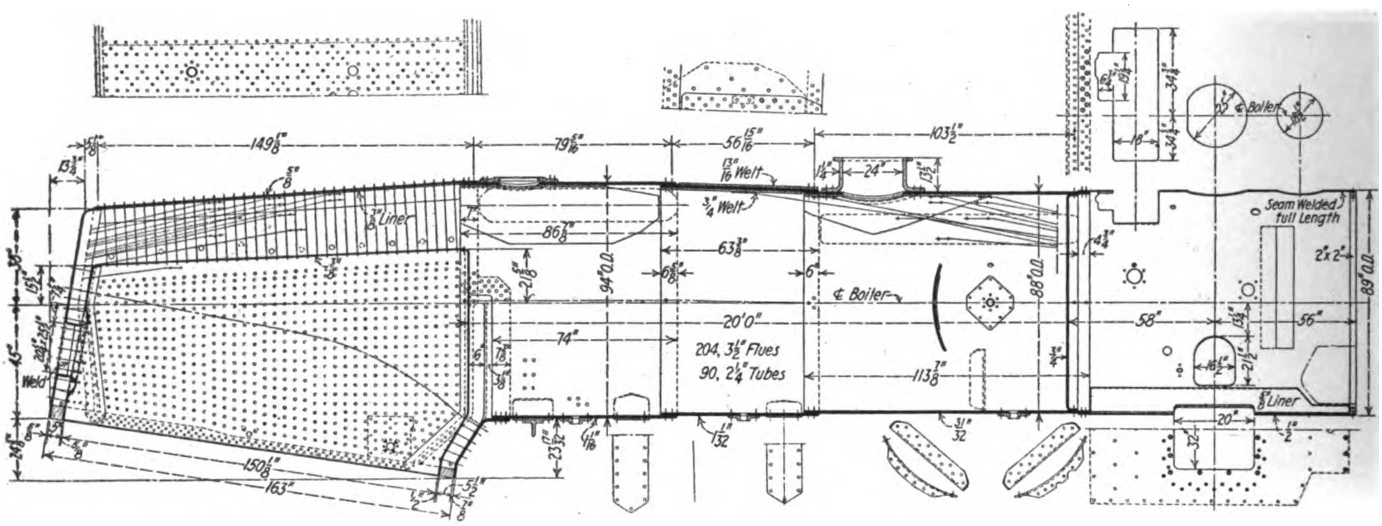
As has already been indicated, the booster drives on the rear trailer axle. This axle has 9-in. by 12-in. journals and 45-in. wheels. The front trailer axle is of standard M.C.B. type, with 6-in. by 12-in. journals and 36-in. wheels. The booster frame and cylinders are located back of the rear trailer axle and are suspended from the trailer frames by a cast steel yoke. The arrangement is shown in one of the photographs included in this article.

One of the greatest problems in connection with the use of the limited cut-off is to provide for the increase in the main crank pin and driving box loads which results from the high initial piston load. The solution of this problem has been attacked in an original manner in the new 2-8-4 type locomotive.

The driving rods

The main rod is built in two parts, one of which drives directly on the main crank pin, while the other carries back part of the load to the rear crank pin, thus relieving the main crank pin of one-quarter of the full driving load. This rod arrangement is shown in one of the photographs.

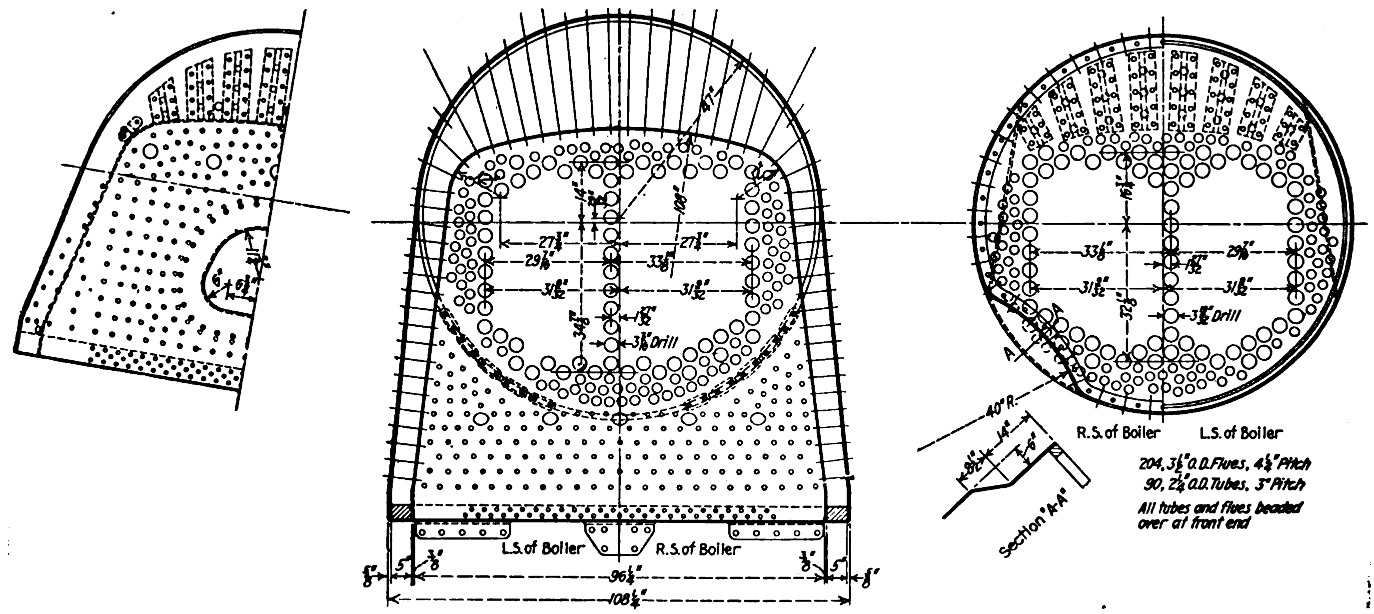
The back end of the main rod proper is forked to receive the parallel section of the main rod. With the two parts of the rod thus assembled, a heavy steel bushing is pressed into the forked end of the main rod proper, holding in place and providing a bearing for the parallel section of the rod. This bushing transmits directly from one section of the rod to the other, the portion of the load which is carried back to the rear wheel. Inside of the steel bushing is a floating bronze bushing which serves as a crank pin bearing. The usual side rod arrangement distributes the driving load forward from the main crank pin to the second and first crank pins. This arrangement, by relieving the main pin and reducing the size of the middle connection bearing made possible the same spread of cylinders, with 240 lb. boiler pressure as was formerly used with 200 lb. boiler pressure.



Longitudinal section of the boiler

By the use of the floating bushing on the main pin, which may be pulled and replaced without removing the rod from the pin, it is expected that no difficulty will be encountered in enginehouse maintenance because of the weight and size of this main rod and that, indeed, the amount of work may actually be reduced.

Here again, as in the case of the cast steel cylinders, this rod arrangement was subjected to a service test of considerable duration on a 4-8-2 type locomotive before the design of the new locomotive was laid down. The experience thus obtained indicates that it is practicable.

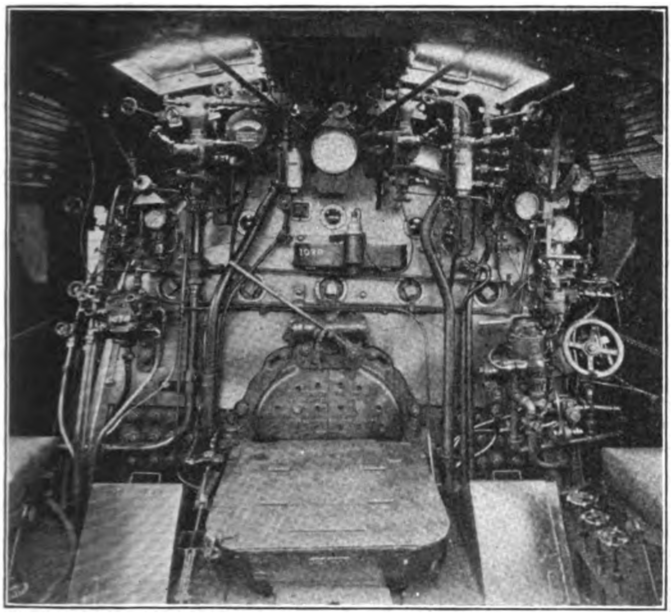


Sections through the firebox and smoke box

Unbalanced cut-off at starting

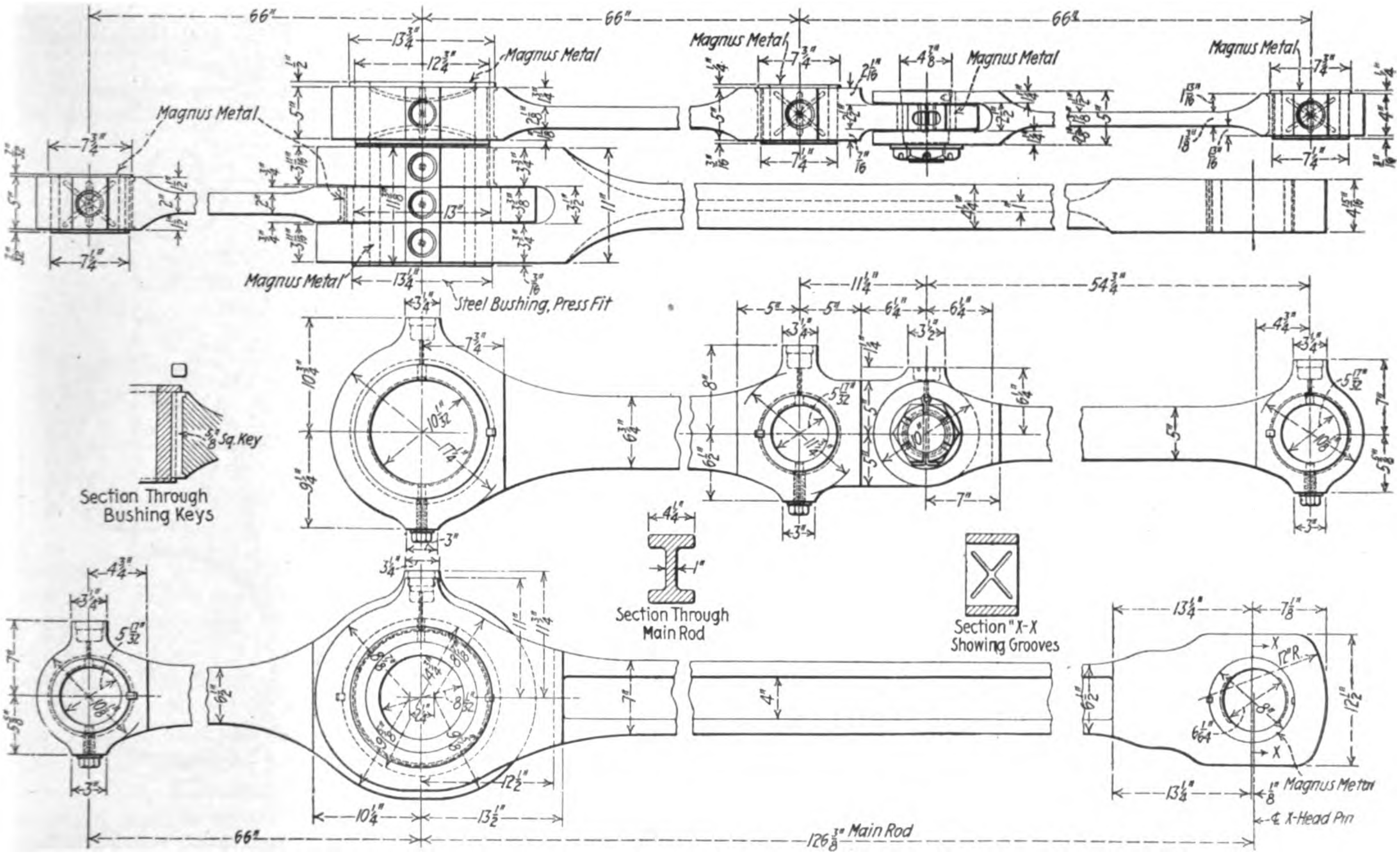
In addition to the auxiliary starting port which is regularly incorporated in the valve chamber bushings of

limited maximum cut-off locomotives, the cut-off at the front end of the cylinder is increased slightly over that at the rear end at starting and very slow speeds, by lengthening two of the ports in the front valve chamber



The interior of the cab

bushing. The ports are 2-3/16 in. wide and in the front bushing two of the top ports are increased 7/16 in. in width toward the center of the valve piston chamber.



Details of the articulated main rod and the side rods (patented)

This simple expedient effectively increases the period of steam admission at slow speeds, but as the speed increases the amount of steam admitted through the extension of the two ports gradually decreases until it becomes negligible in its effect on the cylinder events. For a nominal 60 per cent cut-off, the ports and valves are proportioned to give an actual cut-off of about 60 per cent in the rear end of the cylinder and 63 per cent in the front end.

Boiler equipment

Aside from the size of the firebox, the boiler does not differ materially from the usual type of design. It is slightly larger in diameter and contains a somewhat different tube sheet layout with more heating surface than that of Locomotive 8000. The points of most interest are shown in the photographs. It will be seen that steam is taken from the dome through an outside dry pipe to the Type E superheater header at the rear of the smokebox.

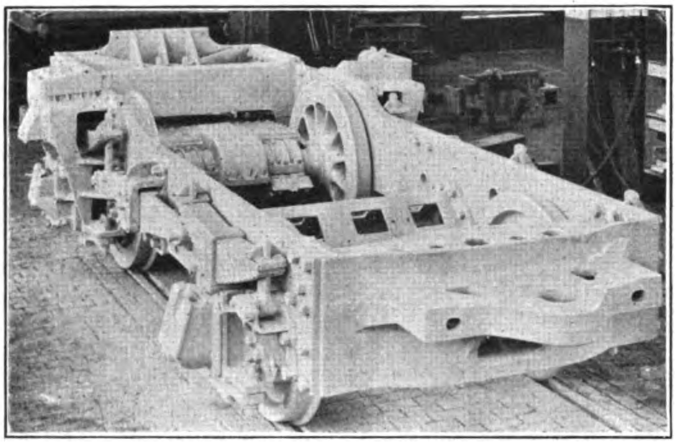
The throttle is located in the smokebox just ahead of the smoke stack. The single steam connection from the superheater header to the throttle is cast integral with the throttle casing. Branch pipe connections are provided on either side of the throttle casing from which the branch pipes lead down inside the front end, passing outside at points just above the cylinders.

Above the superheater header, an opening in the top of the smokebox permits access to the superheater unit bolts which are placed with the nuts at the top. Unit joints may thus be tightened without the necessity of entering the front end.

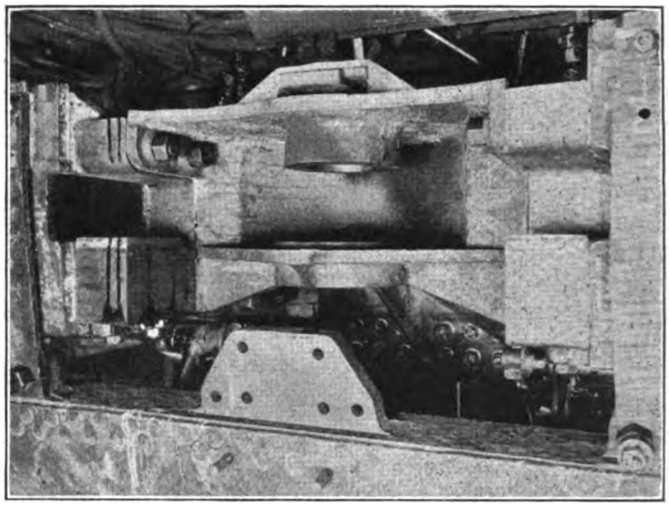
There are two turrets from which steam is distributed to the auxiliaries, both located over the top of the boiler just in front of the cab. One of these furnishes saturated steam to the injectors and lubricators. The other draws superheated steam from the throttle pipe connection to the superheater header for use in the air pumps, the feed water pump, the blower, grate shakers, stoker and headlight generator. The whistle, which also uses super-

heated steam, has its connection welded directly on the steam pipe which feeds the turret. Steam for the booster is taken from the left branch pipe and its exhaust is carried up outside of the smokebox, opening to the atmosphere just in front of the smokebox.

It will be seen from the photographs that two channels of rectangular section are let into the sides of the smokebox. These are provided to take the exhaust steam pipes leading to the feed water heater, which is mounted on brackets in front of the front end, without projecting outside the surface of the smokebox shell. Recesses are also formed in the lower quarters of the front end door ring and in the sheets immediately back of it, to clear the tops of the air compressors, one of which is mounted on a bracket on each side of the front deck casting.



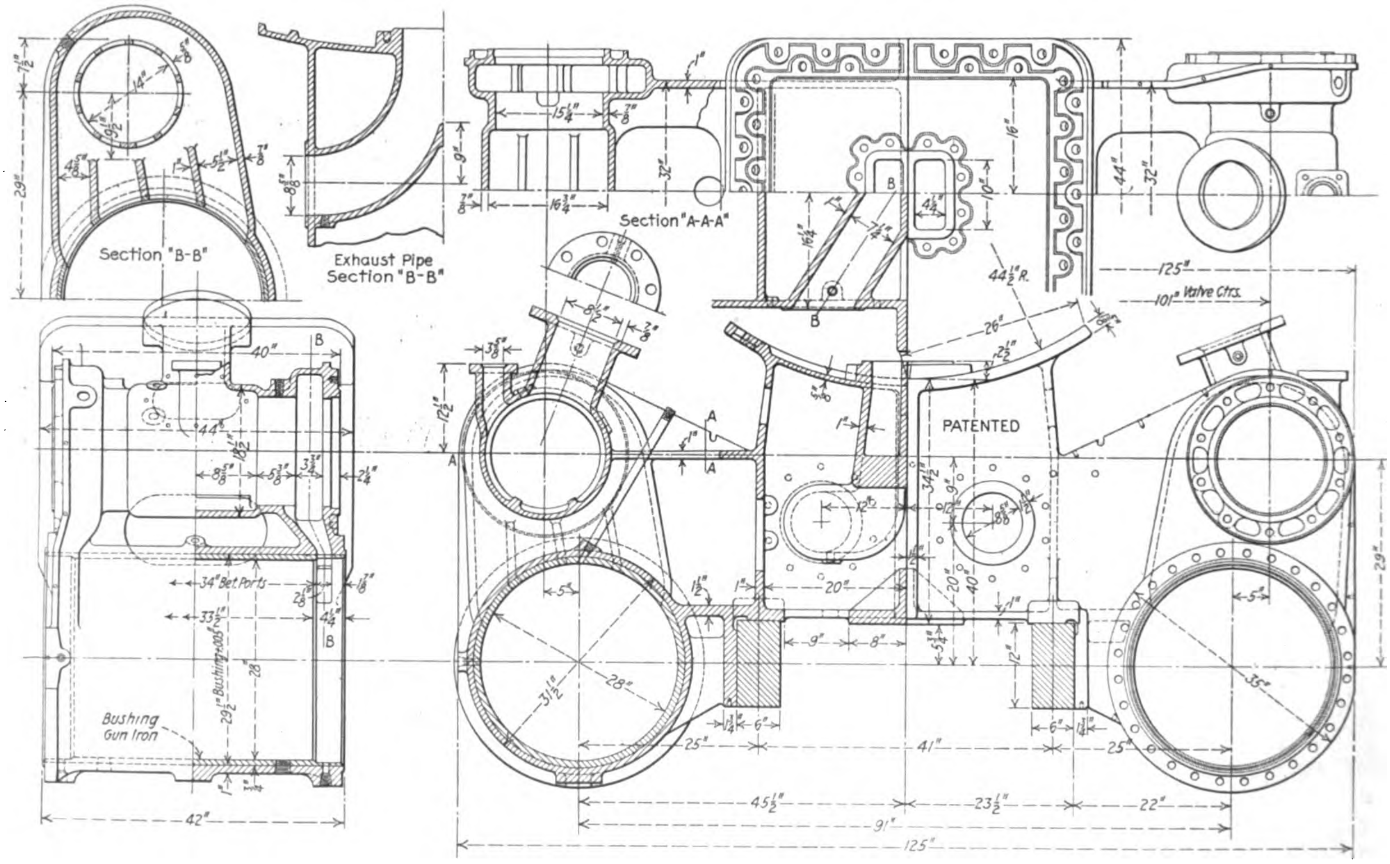
The trailer truck before the ash pan was applied—The side frames are 3 in. by 17 in. in section at the rear deck casting and 3 in. by 21 in. in section between the axles—The journal box pedestals are closed with binders



Looking into the trailer hinge casting at the rear ends of the main frames

Cab arrangement

In arranging the control valves and equipment located in the cab, considerable attention has been given to providing for the convenience and comfort of the engine crew. As far as possible all gages have been brought together in one location where the engineman can see them at a glance. A pneumatic whistle valve has been placed on the side of the cab where the engineman does not have to reach to operate it. The various valve handles have been grouped and labeled, with those most frequently



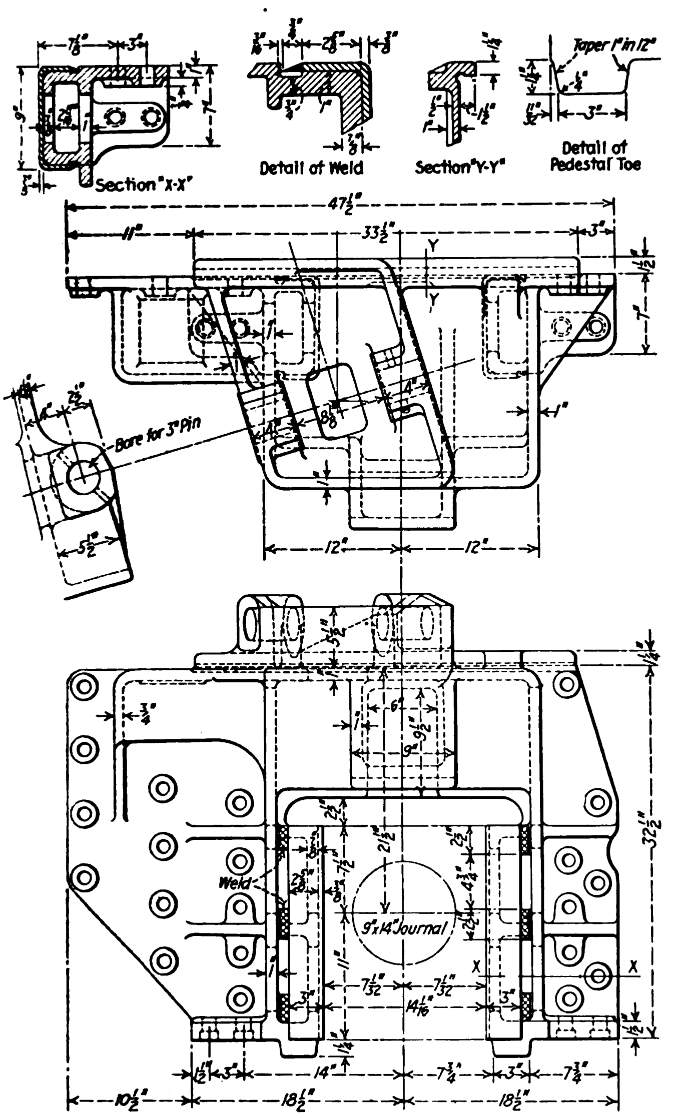
The design of the cast steel cylinders (patented)

operated placed where they are most readily accessible.

Folding spring cushioned seats, the frames of which are supported on coil springs, are provided on both sides of the cab. Back of the fireman's seat is a locker for clothing.

Tractive force fixed by trial

In designing the locomotive considerable latitude was provided for the selection of the final working boiler pressure and maximum cut-off. This was done in order that the maximum cut-off might finally be determined as the result of trials in actual road service. To this end the



Combined rear trailer journal box and lateral motion bearing—the roller which revolves on a 3 in. pin, is geared to the self centering top bearing plate (patented)

locomotive was equipped with a variable exhaust nozzle, the design employed by the Paris, Lyons & Mediterranean having been selected as meeting the requirements of a thoroughly tested and practical device. This nozzle is not intended for manual control by the engineman, but its operating arm is secured to a graduated quadrant on the outside of the front end which permitted adjustments in exhaust nozzle area to be made as frequently as might be desired during the adjustment process without the necessity of entering the front end.

In developing the design of this locomotive, the builders set up the following requirements: That it must be able to handle the same train in drag freight service with 20 per cent less coal than is burned by the Locomotive 8000 design; that, in high speed freight service, it must pull the same train at the same speed as Locomotive 8000 with 12 per cent less coal, or deliver 10 per cent more drawbar pull for the same amount of coal. Experience with the locomotive so far indicates that it will fully meet and probably exceed these requirements. The locomotive is now undergoing tests in service, from which more complete data will later be available.

The principal dimensions and data are shown in the following table:

Type of locomotive	2-8-4
Service	Freight
Cylinders, diameter and stroke	28 in. by 30 in.
Valves, piston type, size	14 in.
Maximum travel	8¾ in.
Outside lap	2 1/16 in.
Exhaust clearance	1/16 in.
Lead in full gear	¼ in.
Cut-off in full gear, per cent	60
Weights in working order:	
On drivers	248,200 lb.
On front truck	35,500 lb.
On trailing truck	101,300 lb.
Total engine	385,000 lb.
Tender	275,000 lb.
Wheel bases:	
Driving	16 ft. 6 in.
Rigid	16 ft. 6 in.
Total engine	41 ft. 8 in.
Total engine and tender	82 ft. 6 in.
Wheels, diameter outside tires:	
Driving	63 in.
Front truck	33 in.
Trailing truck	36 in. and 45 in.
Journals, diameter and length:	
Driving, main	12 in. by 14 in.
Driving, others	11 in. by 13 in.
Front truck	6½ in. by 12 in.
Trailing truck	6½ in. by 12 in. and 9 in. by 14 in.
Boiler:	
Type	Straight top
Steam pressure	240 lb.
Fuel, kind	Bituminous
Diameter, first ring, outside	88 in.
Firebox, length and width	150⅛ in. by 96¼ in.
Height mud ring to crown sheet, back	60½ in.
Height mud ring to crown sheet, front	91¼ in.
Arch tubes, number and diameter	5, 3½ in.
Combustion chamber, length	None
Tubes, number and diameter	90, 2¼ in.
Flues, number and diameter	204, 3½ in.
Length over tube sheets	20 ft.
Tube spacing	¾ in.
Flue spacing	¾ in.
Net gas area through tubes and flues	1,536 sq. in.
Grate area	100 sq. ft.
Heating surfaces:	
Firebox, incl. arch tubes	337 sq. ft.
Tubes	1,055 sq. ft.
Flues	3,718 sq. ft.
Total evaporative	5,110 sq. ft.
Superheating	2,111 sq. ft.
Comb. evaporative and superheating	7,221 sq. ft.
Tender:	
Style	Rectangular
Water capacity	15,000 gal.
Fuel capacity	18 tons
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	64.2
Weight on drivers ÷ tractive force	3.58
Total weight engine ÷ comb. heat. surface	53.3
Boiler proportions:	
Tractive force ÷ comb. heat. surface	9.61
Tractive force × dia. drivers ÷ comb. heat. surface	605
Firebox heat. surface ÷ grate area	3.37
Firebox heat. surface, per cent of evap. heat. surface	6.60
Superheat. surface, per cent of evap. heat. surface	41.4
Tube length ÷ inside diameter	74.5
Comb. heat. surface ÷ grate area	72.2

THE METHODS OF TESTING BRITISH LOCOMOTIVE TIRES do not vary greatly from the methods used in this country. The British tires must not be too brittle or too soft and must have a tensile breaking stress of from 100,000 to 110,000 lb. per sq. in. and finally the steel from which they are made must pass a chemical test as to its content of sulphur and phosphorus. The tires are given a drop test which is not common practice in this country. One tire out of a lot of 50 is placed in an upright position in the base of the testing machine. A ton weight is raised and dropped on the edge of the tire from varying heights. For a tire weighing 950 lb., the weight is first dropped on the rim from a height of 5 ft., then from 10 ft. and finally the fifth blow is received from a height of 25 ft. The tire should not break or be unduly bent. If the diameter of a 950-lb. tire, measured from the point on which the blows fell, is reduced approximately 4 in., it is considered a good tire and the lot is passed as fit for service.

Railway motor car service on the C. G. W.*

By E. J. Brennan

Superintendent of motive power, Chicago Great Western, Oelwein, Iowa

In the past year quite a few additional cars of the self-propelled type have been built for various railroads, and the Chicago Great Western has installed in the interim, one gas-electric car, two mechanical gear-driven, two-car trains and one steam car. The following data relate to these cars:

Gas-electric car M-300

Length of body	57 ft. 4 in.
Width	9 ft. 8⅝ in.
Weight	76,400 lb.
Baggage compartment	156 sq. ft.
Seating capacity	50
Type of body construction	steel
Standard A. R. A. journal bearings	4¼ in. by 8 in.

Two Sykes trains Nos. M-207, MT-208, M-209 and MT-210

Total length of motor car	46 ft. 10 in.
Total length of trailer	52 ft.
Width	8 ft. 6 in.
Weight of motor car	50,000 lb.
Weight of trailer	36,400 lb.
Baggage compartment	120 sq. ft.
Trucks equipped with Hyatt roller bearings.	
Seating capacity, motor car	30
Seating capacity, trailer	52
Type body construction	steel

The steam car has been developed by installing in the forward end of a McKeen car a tubular boiler, automotive type, working at a pressure of 500 lb. actuated by an oil-fired furnace. The engine in this unit is a six-cylinder compound having three low pressure cylinders, 7-in. bore by 7-in. stroke, and three high pressure cylinders having a 5-in. bore and a 7-in. stroke. This steam car has been handling a 35-ton combination mail and baggage car 55 ft. long making a total light weight of the train, 90 tons, or an average loaded weight of approximately 100 tons. This car has been in service between Oelwein, Iowa, and Ft. Dodge, a distance of approximately 260 miles a round trip each day, making 44 stops averaging 1¾ min. each on a schedule of 24.2 miles per hour.

The above reference to the steam car is preliminary to a final report which will be made by the builders after certain changes now being made to the engine and boiler have been completed and further data compiled at which time an official announcement will be made.

In the various units of equipment recently built, U. S. standards and steam railway practices have been followed in the general construction except the weights, which, generally speaking, are consistent with that type of equipment. In other words, the body design while it is of far lighter construction than standard railway coaches, combination cars, etc., is somewhat heavier than some of the more recently built rail motor cars.

Gas-electric car pulls heavy trailer

Our gas-electric car, although designed to haul a 35-ton coach or trailer, at this time is doing very much more. The car is and has been operating between Osage, Iowa, and Hayfield, Minn., in local main line passenger service, pulling a combination mail and express car weighing 54½ tons, a distance of 70 miles each day, or betwen McIntire and Hayfield, on a schedule of 26 miles an hour. The entire daily run for the car is only 104 miles, 70 of which, as stated, is traveled handling the 54½-ton combination car.

A few minor defects have developed on this unit but they have been very quickly corrected.

The control of the gas-electric car (described on page 371 of the August 30, 1924, *Railway Age*) is very dependable in that it is operated by a control similar to that of a steam locomotive. The first notch on the throttle operates an air starting system which allows the operator to stop the entire power plant by simply closing the throttle and to start the power plant and the car by opening the throttle when he is ready to proceed. This results in a noticeable economy in fuel consumption and maintenance, as gasoline engines develop carbon very rapidly when idling. This system of operation fits in well on steam railroads due to using locomotive enginemen for operators. This car is heated throughout by an Arcola hot water heater to which the builders have attached the water circulating system of the engine so that when the car is obliged to lay over during severe weather it is not necessary to drain it and the possibility of the radiator, piping, engine and other appurtenances freezing is eliminated.

The next two trains for the Chicago Great Western were purchased from the Sykes Company, St. Louis, and are similar to the preceding units except that they are considerably better owing to the inclusion of certain refinements incorporated as a result of our past experience. This refers to better construction of the body which did not materially increase the weight and an increase of at least 50 per cent in the strength of all driving parts. The trains referred to have been built somewhat longer than our previous units to provide more passenger seating capacity as well as additional baggage carrying facilities. A few changes have been made in the spark control of the engine which caused some trouble on account of not being fitted up substantially enough for the service in that a pressed fit was used which we were later obliged to weld solid in order to get it to hold. A roller bearing is used in the trucks of these cars which gave us trouble in the beginning owing to the inner sleeve of the bearing not being applied tight enough. Due to this the sleeves would work off the axle, come in contact with the outer bearing cap and generate sufficient heat to burn up the packing and lubrication, causing a complete failure. This can be overcome by adhering more closely to the mounting pressures recommended by the A. R. A. and used universally in American steam railroad shops. A better system of electric generation and storage by means of an axle lighting device and storage battery has been arranged for.

Sykes trains make 260 miles a day

One of the two Sykes trains referred to is running between Ft. Dodge, Ia., and Council Bluffs, a distance of 268 miles a day, every day. The motor car of the other train is operating between Oelwein and Ft. Dodge, a distance of approximately 260 miles a day, every day, and

*From a paper read on March 26, before the Minneapolis Section of the Society of Automotive Engineers.

is handling a mail and express car that weighs 35 tons light with an average of 10 tons of baggage and express, or equivalent to a 45-ton trailer, and is handling it very successfully.

On some of the units of equipment previously purchased, the cars were equipped with traction brakes which could not be operated in connection with standard steam railway automatic air brakes. These have been changed over, however, and we strongly urge from our experience that future units of motorized equipment be supplied with brakes that will operate in conjunction with the standard coaches, the foundation brake gear on some of the motor cars has been constructed too light, and not enough attention has been given to it generally with respect to clearances as the various parts wear. Instances have been known where, with the slightest amount of lost motion, the brake levers would strike some part of the truck frame before the average brake cylinder piston travel was experienced.

A small gas locomotive

The Chicago Great Western also has on order at this time, but its construction has not been completed as yet, a 25-ton six-wheel gasoline switching locomotive that it is proposed to operate on a branch line running from Cedar Falls Junction to Cedar Falls, Iowa. This locomotive is being built by the Baldwin Locomotive Works and is designed to pull about five loads and one coach at a maximum speed of 18 miles per hour.

These various units of equipment are indicative of the trend in design of motorized equipment on steam railroads. Three years ago we were talking single cars with a baggage space of approximately 50 sq. ft., seating capacity from 36 to 40 passengers, light weight approximately 15 tons, designed to run 40 miles an hour on level track. In this short period of time we have realized the 100-ton motorized train, traveling at 50 miles an hour.

It would be opportune to say at this time also that we are getting very fair service out of our older units of motorized equipment including the first Sykes train, the Service car and the McKeen cars.

Gasoline motor car data

Motor Car	Trailer	Period covered	Miles run	Cost per mile run, cents: Operation	Maint.	Total	Miles run per: Gal. gas.	Pt. oil
M-200	MT-201	Oct. 1922 to Jan. 1925.	59,304	22.92	11.30	34.22	4.01	13.62
M-205	MT-206	Aug. 1923 to Jan. 1925.	65,870	21.16	7.33	28.45	2.62	11.36
M-300	......	Aug. 1924 to Jan. 1925.	18,914	23.29	4.68	27.97	2.14	10.42
M-400	......	Nov. 1922 to Jan. 1925.	102,779	19.67	2.66	22.33	5.97	17.60
1001	......	Oct. 1922 to Jan. 1925.	78,982	25.56	8.75	24.13	1.83	7.65
1002	......	Jan. 1925...	1,270	21.67	6.33	28.00	1.23*	4.41
1000	1025	May 1923 to Jan. 1925.	35,410	28.08	20.79	48.87	1.56	3.19
1003	......	July 1923 to Jan. 1925.	75,982	22.60	2.48	25.08	21.27	5.13

*1.23 gal. of fuel oil per mile.

A special maintenance department

The results given above in miles run and costs both for maintenance and operation, also the performance with respect to oil and gas consumption, suggests another very important thought and that is that the Chicago Great Western found it necessary to develop a gas engine department for the care of these cars and this department we know is to a great degree responsible for the successful performance of our motor cars. We have in our gas car organization a motor car expert who is on my immediate staff and whose jurisdiction extends over the entire system in seeing that the cars are maintained and assisting and instructing enginemen who wish to qualify as motor car operators. At our main shops at Oelwein we have a gas engine repair organization consisting of a foreman and several mechanics, helpers and apprentices who are engaged on gas engine work entirely. This refers to heavy and medium repairs particularly. For the light repairs on cars laying over at the engine terminal or roundhouse a specially trained gas engine mechanic is employed to see that the cars and their equipment are properly cared for and repaired.

The Chicago Great Western is now considering the building of a separate repair shop close to but somewhat removed from the main plant owing to the fire hazards existing. The building that we have in mind will be erected consistent with the type and the number of units of equipment that we now have. It will be equipped with special machinery for repairs to our motor cars.

In conclusion, in the construction of motor cars it is always well to bear in mind accessibility in order to facilitate repairs. This refers not only to the truck and body construction but to the engine as well.

Steam for enginehouse heating systems and blower lines*

By H. W. Williams

Superintendent of motive power, Chicago, Milwaukee & St. Paul, Tacoma, Wash.

Low pressure steam is more efficient for heating purposes than is high pressure steam, for the simple reason that the heat content of one pound of steam at low pressure is but little less than at high pressure. For instance, a pound of steam at 125 lb. gage pressure contains 1192.2 B.t.u. while at 10 lb. gage pressure it contains 1160.4 B.t.u. Most engine terminals are at least partially equipped with vacuum return systems but unfortunately it is easier to extend live steam lines than it is the heating mains, consequently in most instances it will be found that the radiation supplied with live steam exceeds the original low pressure installation,

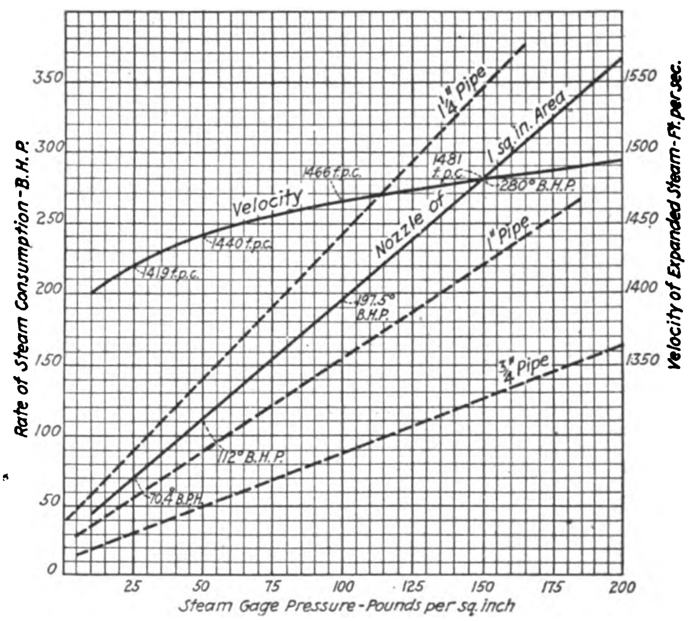


Fig. 1—Rate of steam discharge through nozzles of different size

* Part of a paper read at the annual Master Mechanics Staff Meeting of the C. M. & St. P. held at Milwaukee, Wis., on September 8, 1924.

and further, it quite frequently happens that no traps are provided on the high pressure radiators, in which case the steam is allowed to escape to the atmosphere unimpeded. A radiator full of steam when trapped will give off just as much heat as one where the steam is permitted to blow through to the air.

An illustration of what happens when steam is allowed to blow through a radiator into the atmosphere unobstructed is as follows: A pound of steam at 10 lb. gage pressure will give off 10 B.t.u. and a pound of steam at 125 lb. gage pressure will give off 42 B.t.u., whereas, if properly trapped and allowed to condense, a pound of steam at 10 lb. gage pressure will give up 980 B.t.u. and a pound of steam at 125 lb. gage pressure will give up 1,012 B.t.u. while as a matter of fact, the effect on the room temperature is the same in either case because the radiator will be no hotter in one case than the other, provided the condensation is drawn off properly. In other words, if steam is allowed to blow through the radiator unimpeded,

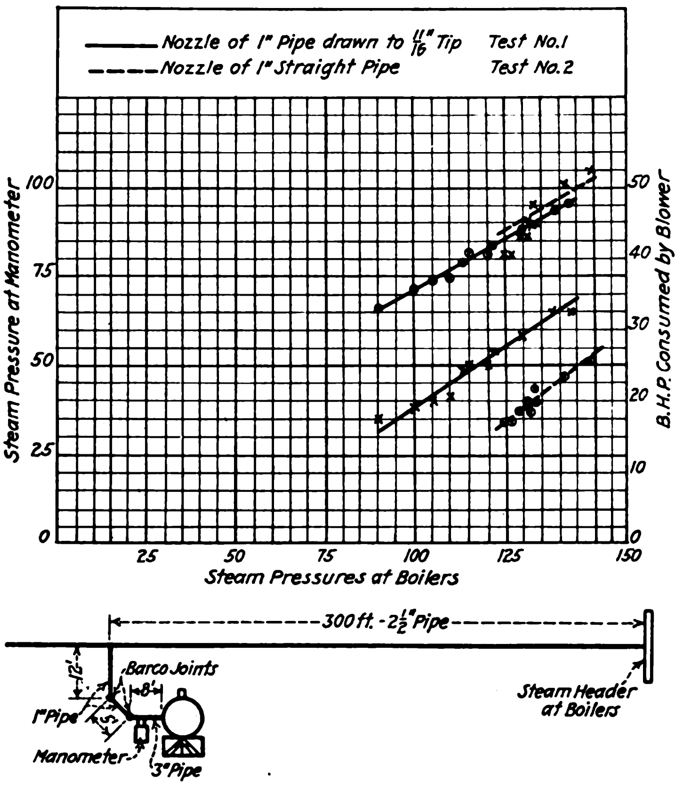


Fig. 2—Actual steam discharge through straight end drawn nozzle tips determined by tests at the Western avenue, Chicago, enginehouse of the C. M. & St. P.

it will require 92 times as much steam at 10 lb. gage pressure and 24 times as much steam at 125 lb. gage pressure to produce the same amount of heat as could be obtained with one pound of steam in either case if the radiators were properly trapped. In addition, there is still 180 B.t.u. in each pound of steam after it has condensed that may be recovered with a properly operated vacuum return system. Bearing in mind that at 10 lb. gage pressure there will be 275 lb. of steam per hour discharged through a ½-in. pipe which, on the basis of 6,000 B.t.u. equivalent per pound of coal, will approximate 50 lb. of coal per hour, it will be evident that this feature has an appreciable effect on the coal consumption.

There are no doubt instances where the installation of a properly installed vacuum return system, which would include all the radiation, would give the same relief as the installation of an additional boiler in the power plant.

Another heavy steam consumer at engine terminals that is not always fully appreciated is the roundhouse blower line. The amount of steam that blows out through the locomotive stack while firing up an engine depends entirely upon the amount of steam that the blower pipe line can carry. Fortunately in most instances the distance from the boilers is so great and the blower pipe line is so small, particularly where it drops down to connect to the front end blower, that the steam pressure has dropped sufficiently to hold the steam consumption to a reasonably small amount. Fig. 1 shows the rate of discharge of steam into the atmosphere for varying steam pressures from pipes of different sizes. The heavy line indicates the amount of steam discharging through a nozzle of 1 sq. in. cross sectional area. The blower arrangement in the majority of the engines consists of a 1¼-in. pipe, which, if there were unrestricted volume back of it, would consume steam at 150 lb. gage pressure at the rate of 345 boiler hp. However, on account of the small pipe sizes used in the blower line and blower line drops, the actual consumption is very much less than 150 lb. of steam.

In order to determine just what this amounts to, some actual measurements were taken recently at Western avenue. The test results are shown graphically in Fig. 2. From these it is determined that with boiler gage pressures between 125 and 150 lb. the steam consumed is between 40 and 55 boiler hp. This will vary with the steam pressure and will be effected somewhat by the distance from the boiler room, owing to the pressure drop in the main pipe line. However, the greatest pressure drop occurs in the small pipe and connections between the blower line and the front blower connections, as this is usually reduced to a ¾-in. pipe connection. From this and other information collected on the subject, it may safely be assumed that the average consumption for blowers is no less than 50 hp. With the blower on for 45 min. this would represent about 225 lb. of coal (6 lb. per boiler-hp. hour).

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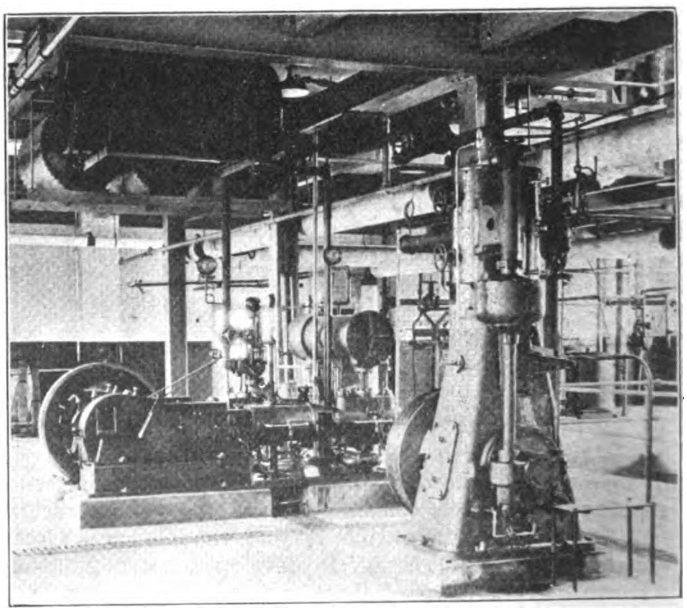
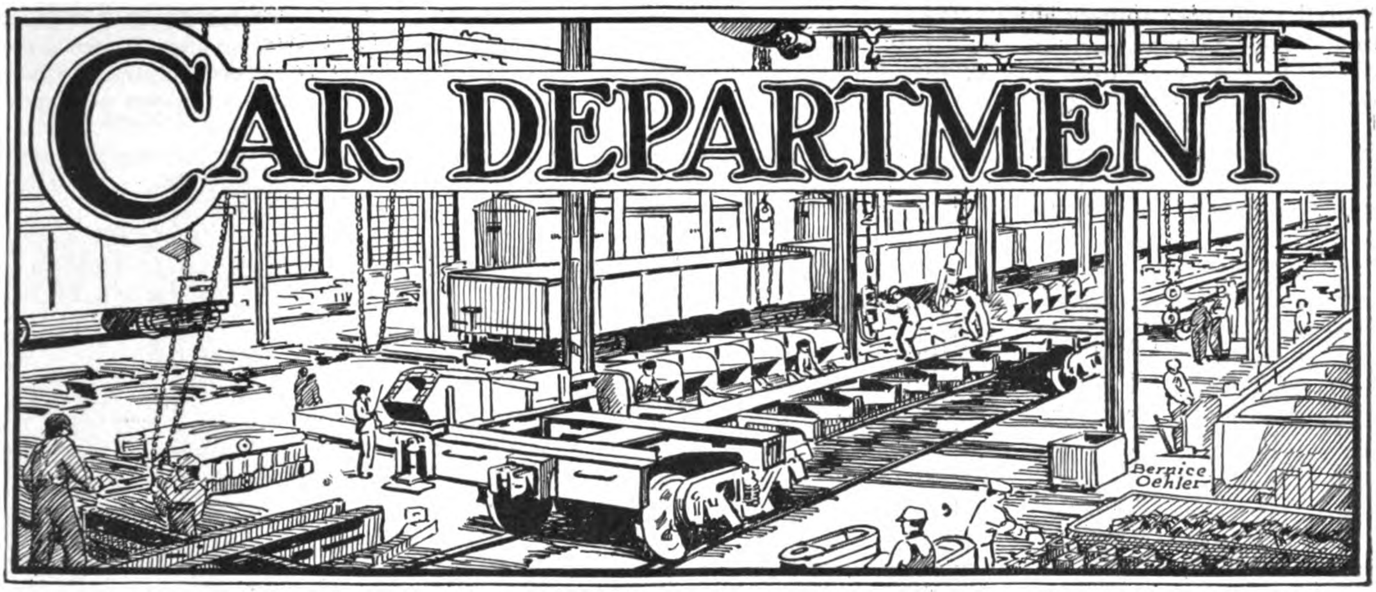


An interior view of the steam laboratory at The Pennsylvania State College, showing a Kingsford-Stumpf vertical unaflow engine in the foreground and a Chicago pneumatic compound-steam, two-stage air compressor in the background.



Turtle-back roof applied to B. & A. suburban cars

Maximum seating capacity with convenient facilities for prompt loading and unloading—Vestibule ends economically constructed

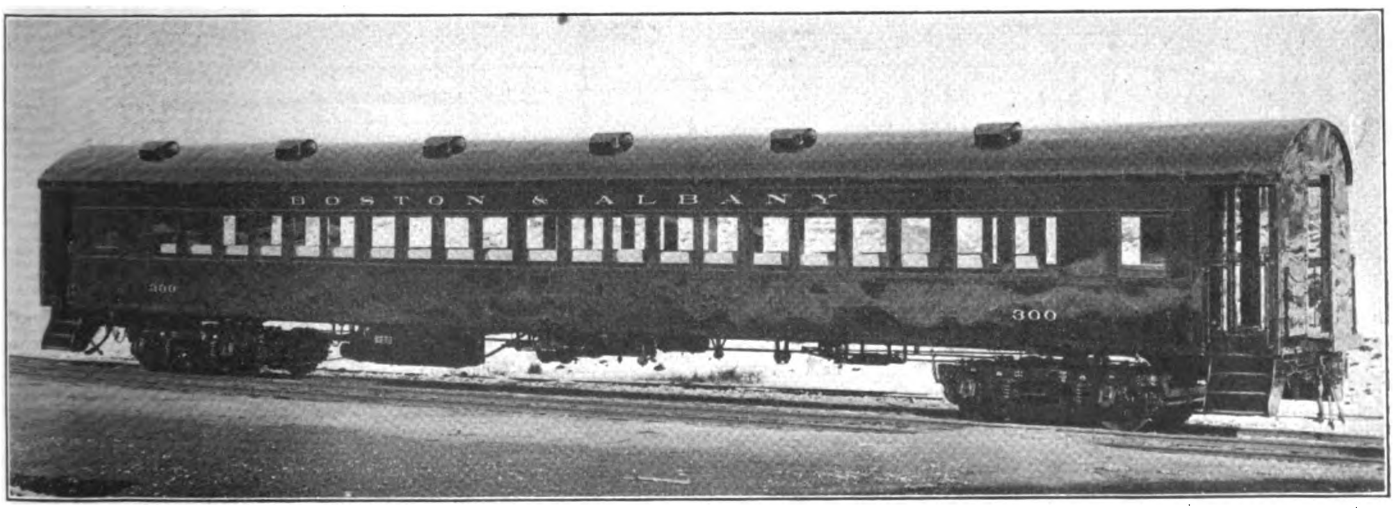
An order of 50 steel suburban passenger coaches built by the Osgood Bradley Car Company, Worcester, Mass., has recently been placed in service by the Boston & Albany. The passenger cars now used on the main line and the highland branch between Boston, Mass., and Riverside, will be replaced by this equipment.

Before designing this equipment the problem of handling suburban passengers in and out of Boston was carefully studied, after which it was decided that the utmost seating capacity with convenient facilities for promptly loading and unloading were demanded by the conditions. Features of the cars which help to attain these ends are the ample space provided at each end of the car for standing room, the wide end doors and wide steps with four treads and the fact that the seats have no arms, which adds considerably to the ease of passage through the aisle and entrance into the seats.

Underframe frame construction equal to that of coaches in through passenger service

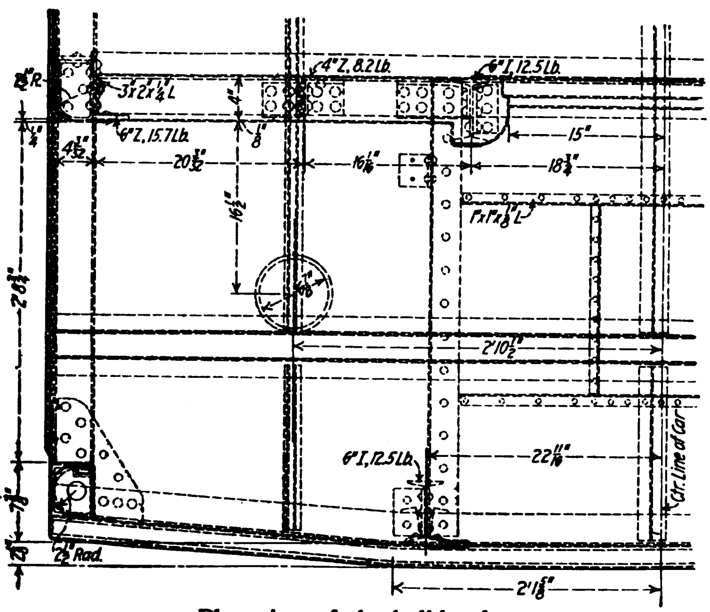
The cars are of steel construction throughout, with steel interior finish. The underframe and superstructure details have been so designed that their strength is equal to that of coaches in through passenger service.

The center sills consist of two 12-in., 35-lb. channels,



Steel suburban passenger coach with seating capacity for 100 passengers

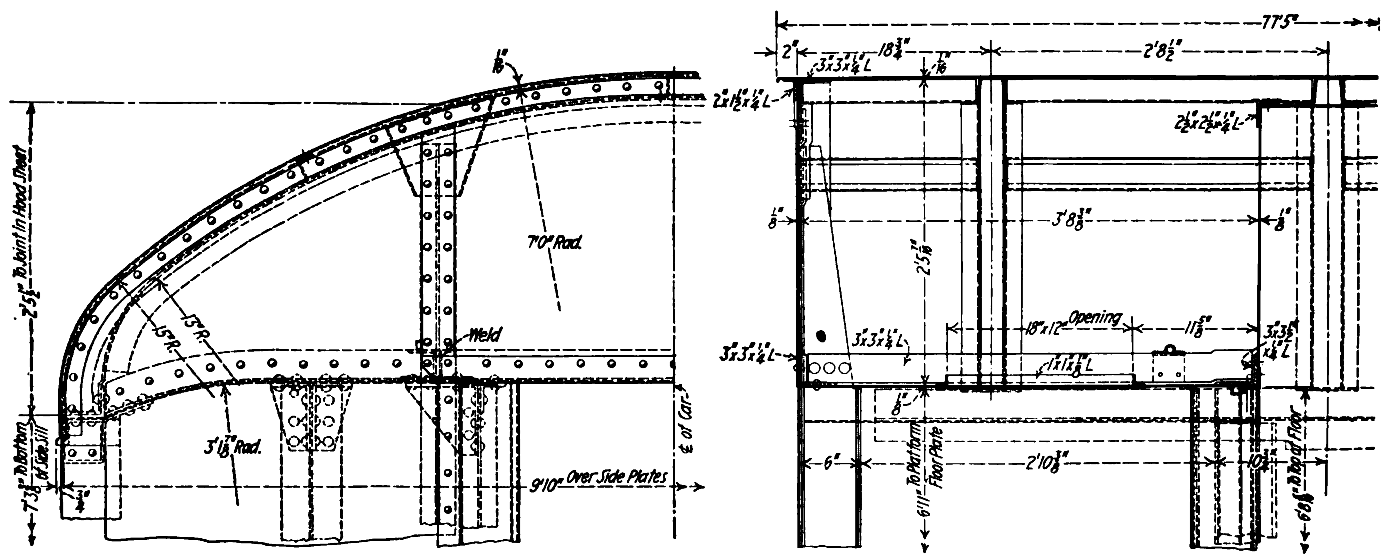
spaced 18 in. back to back and riveted to the bolster castings. Each channel is reinforced at the bottom by a 3½-in. by 3-in. by 7/16-in. steel angle. The cover plate is 28 in. by ¼ in. extending between the bolster centers. Cast steel body bolsters and platforms make up the two ends of the underframe construction. The side sills are 5-in. by 3½-in. by 7/16-in. rolled steel angles. The side and center sills are tied together with three ¼-in., pressed



Plan view of the bulkhead

steel, flanged, crossbearers provided with ¼-in. cover plates.

The 12 floor supports form additional underframe members and consist of ⅛-in. pressed steel channel shapes. Riveted to the pocket in the bolster casting at each end of

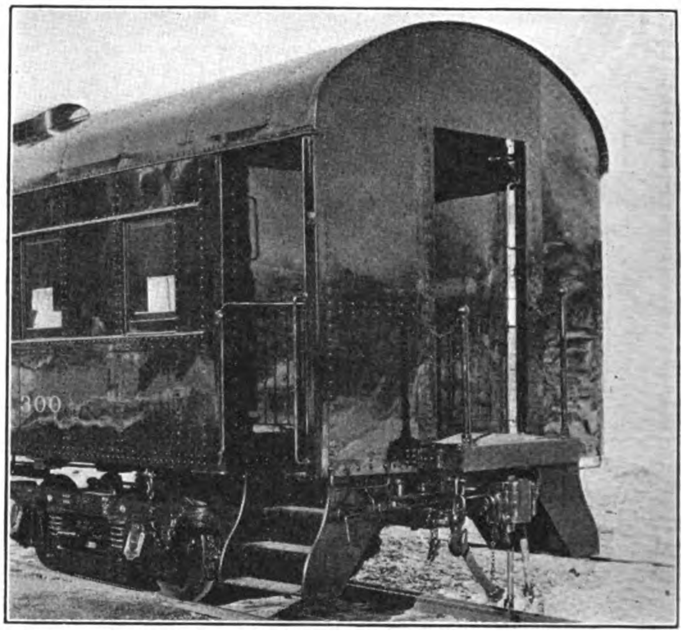


Longitudinal and cross section of the vestibule roof

the car, are two end door posts which consist of 6-in., 12½-lb. I-beams. At each end of the car riveted to the bolster casting are two intermediate end posts made from 4-in., 8.2-lb. Z-beams. The 6-in. Z-beam body corner posts are riveted to the bolster casting.

Turtle-back roof effects savings in materials

The roof is of the turtle-back type. The construction consists of 28 carlines of the flanged channel type made of 3/32-in. steel plate. There are three purlines of ⅛-in. pressed steel, Z shapes, fitted between the carlines. The roof sheets consist of 1/16-in. steel sheets, extending from the side plates in one piece. The roof sheets are butted



Turtle-back roof permits economical end construction of the car

together over the carlines and are made tight by welding. The cars have no hood as the roof sheets extend in a straight line to the intersection with the vestibule end sheets. One of the drawings shows a plan of the bulkhead constructed. The roof is provided with 12 Garland type ventilators, with registers in the interior.

Single windows are used in these cars with the sash fitted with O. M. Edwards window fixtures. The seats are spaced so that each passenger is opposite a window. Over the seats are basket racks of the Adams & Westlake type which will provide ample space for commuters' parcels.

The cars are well insulated, having three-ply of ¾-in., special hair felt which covers the entire inside surface of the outside sheathing on the sides and ends of the car, except above the windows. The flooring is composed of

special ⅝-in. corrugated galvanized steel, laid crosswise of the car and covered with Flexolith. The platform floor is covered with Feralun.

Low-arched, light colored ceiling diffuses light

To facilitate reading, the lighting arrangement of these cars has been carefully planned. Along each side of the low-arched ceiling are placed 26 attractive lamps. The head lining is finished in a cream color down to the frieze moulding. This combination of a low-arched, light colored ceiling, diffuses the light so that the passengers can read comfortably. Current for the lamps is furnished by Gould electric light equipment, and each car is provided with a 225-ampere Edison battery. The steam heating system is of the Vapor type, designed to maintain at all times a comfortable temperature on the interior. The cars are equipped with the New York U. C. air brake equipment.

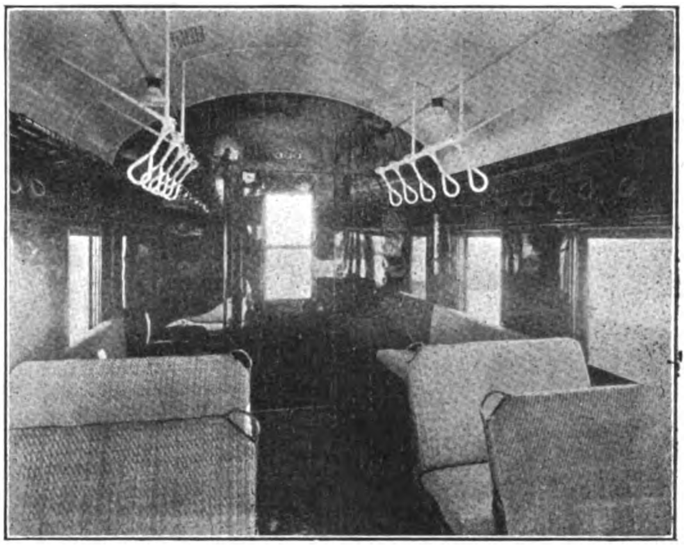
The coaches have seating accommodations for 100 passengers —Ratan seats without arm rests

Four-wheel trucks are used, equipped with the Simplex clasp brakes, and 33-in. forged steel wheels. The small wheels are used to facilitate charging the storage batteries, by their greater number of revolutions. The journals are 5 in. by 9 in.

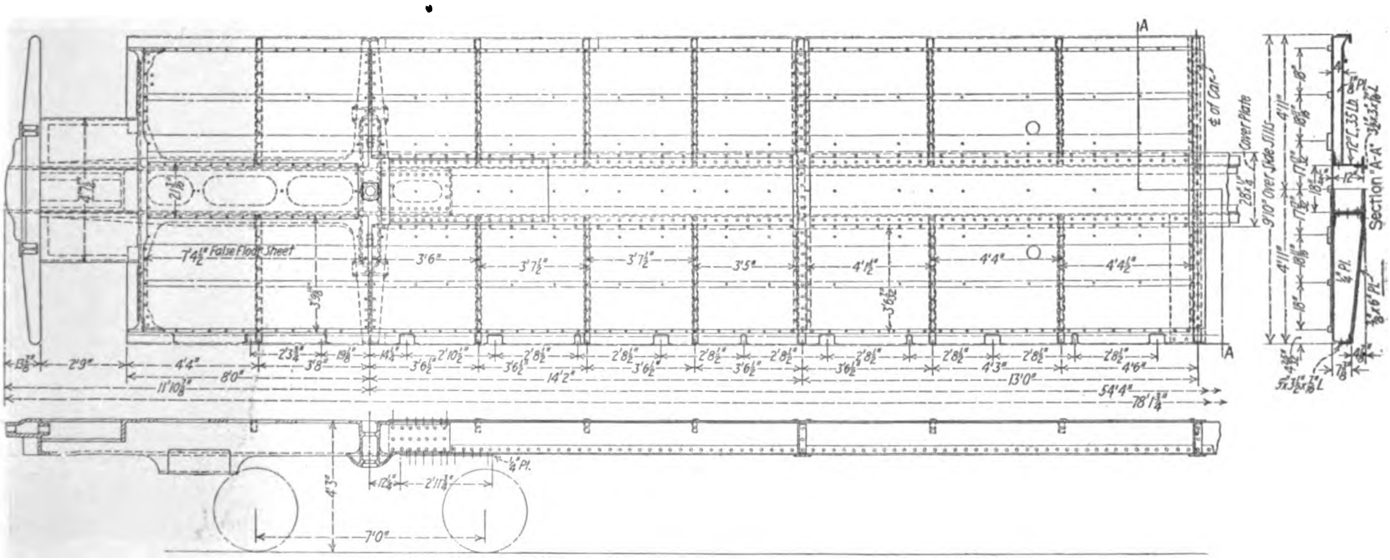
It will be noticed that the end doors have an opening of 2 ft. 6 in. and that considerable room has been provided immediately inside of the doors. The platforms have an opening of 2 ft. 9 in. at the vestibule steps. A standing space of approximately 14 sq. ft. is available. The vestibule steps have four treads and are easy to reach from the platforms at track level.

Weight per seated passenger slightly over 1,000 lb.

The empty weight of these cars is 101,500 lb. With a seating capacity of 100 persons the weight per seated passenger is but slightly over 1,000 lb. The over-all length of the cars coupled is 78 ft. 11¾ in.



Ample standing room and overhead hand straps are provided at the ends of the cars



Underframe construction of the Boston & Albany suburban cars

A WAGE INCREASE of two cents an hour has been granted by the Atchison, Topeka & Santa Fe to its shop crafts employees on all lines.

Enginemen and firemen on the Southern Pacific lines in Texas and Louisiana have been granted a wage increase of approximately 5 per cent, retroactive to September 21, 1924. This increase is in line with similar ones which were awarded previously on the Southern Pacific, Pacific system, and on other western roads.

D. L. & W. Hoboken, N. J. terminal, which handles from 66,000 to 67,000 commuters daily

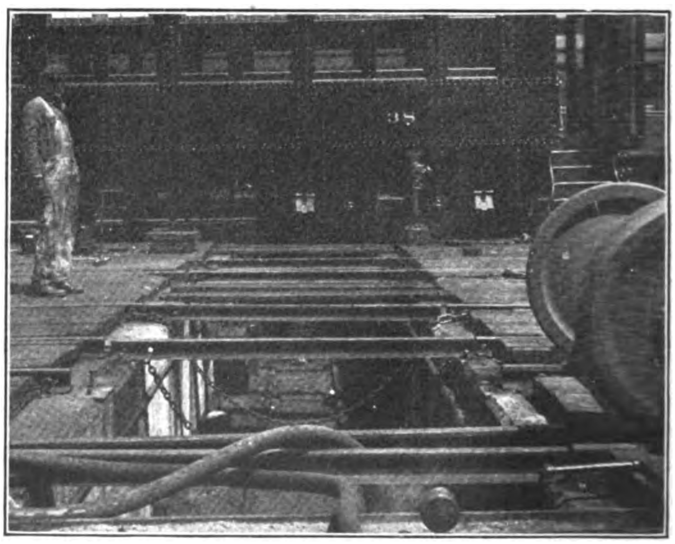
D. L. & W. coach maintenance at Hoboken, N. J.

Adequate facilities and organization have increased the time between shoppings—Paints emulsion cleaned every five months

THE terminal maintenance of passenger equipment is one of the big problems of the car department. Just as it is important to provide adequate facilities and efficient organizations for the proper maintenance of locomotives at terminals, so is it essential to provide the proper facilities and organization for the terminal maintenance of passenger equipment. The principal object of this plan is to increase the length of time between the shopping of cars and, in doing so, keep the number of cars going in the repair shops down to a minimum. In other words, the rate of depreciation of passenger equipment is decreased with the increased efficiency of terminal maintenance.

Blacksmith forge located near repair tracks

The maintenance of passenger car equipment at the Hoboken, N. J., terminal of the Delaware, Lackawanna & Western is based on the above principles. Proper facilities and organization are necessary to handle the cars at this terminal, as 115 suburban trains and 10 main line trains are dispatched every 24 hours. Approximately 450 suburban cars make 700 arrivals and 150 main line cars enter Hoboken every day which gives a total of about 850 car arrivals. Between 66,000 and 67,000 commuters pass through the Hoboken terminal every day.

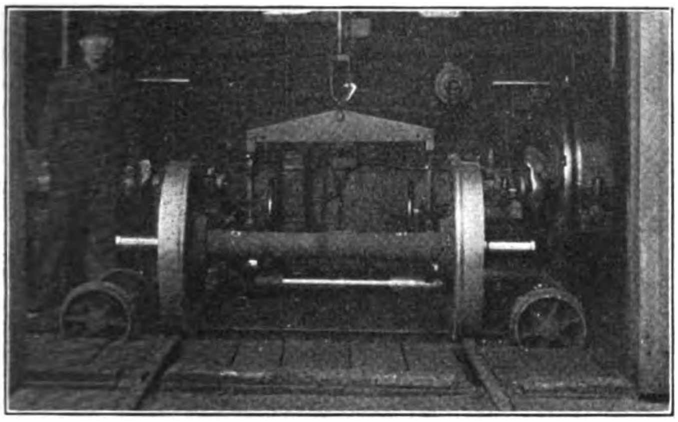


Four track drop-pit located 60 ft. from the wheel lathe

The train and car arrivals have been carefully analyzed by means of graphic charts which show the number of cars arriving and leaving each hour of the day. This graph indicates the rush periods and serves to act as a guide for putting on the maximum working force and the best time of the day to take the cars out of service for repairs.

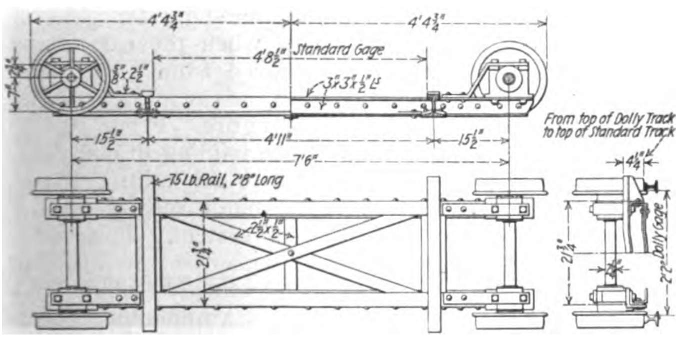
Method of cleaning cars

A schedule has been worked up by which the cars are cleaned on an average of once every five months by an emulsion cleaner. The controlling factors used in preparing this schedule are the condition of the cars, the service they are in and the time out of the shop. The length of the period between general repairs depends largely on the condition of the paint on the car.



Pair of wheels on the dolly truck ready to be placed on the outbound track

To retain the lustre and preserve the paint, the cars are passed through a coach cleaning shop which has two pit tracks with a capacity of six cars. The cars are taken from service after the morning rush hours, passed through the shop and put back in service in time to handle the evening peak traffic. There are six men in this shop who work on a piece-work basis. The exterior of the cars are cleaned with an emulsion cleaner which removes all of the dirt and grime from the paint and gives it a finished appearance. If the interiors of the cars need cleaning, the paints are washed or renovated which returns the paint to its original lustre. Of course, the floors and lavatories are thoroughly scrubbed and cleaned. Cars on the through trains are either emulsion cleaned, washed or repainted, depending on the condition of the paint. Between the working hours of from 8 A. M. to 4 P. M. five cars are passed through this shop without being withdrawn from service. This operation is also carried on in the winter as a temperature of 70 deg. is maintained in the shop.

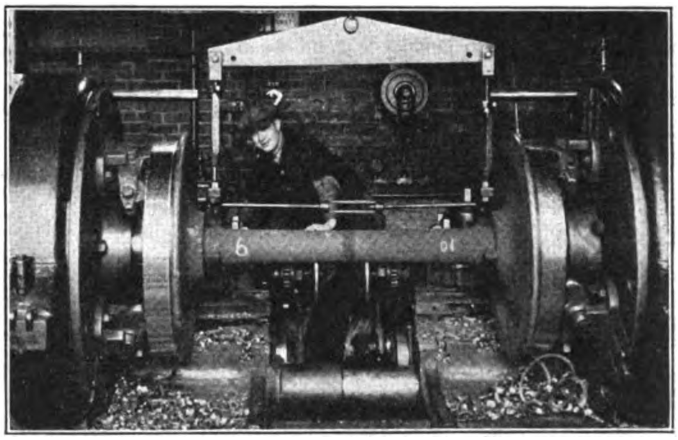


Dolly truck which facilitates the movement of wheels to and from the wheel lathe

Facilities are provided at one end of the coach cleaning shop for the mounting of air, signal and steam hose. During the day a workman from the shop does this work. After the evening rush hours, the terminal car inspectors do this work, as they have plenty of time on their hands between the departure of the evening trains.

Maintenance of car trucks and platforms

All the truck and platform work is done at this point, between the morning and evening rush hour periods without the need of taking the cars out of service. A gang of 12 men is assigned to do the work. A four-track drop pit, which is shown in one of the illustrations, has been provided to facilitate the dropping of wheels. The drop pit is made of concrete and is about 4 ft. deep and 5 ft. wide with a 2-ft. 2-in. dolly truck at the bottom passing under the four tracks. The car truck containing the pair of wheels to be removed is placed over one of the pits. When the wheels are ready to be removed, a small four wheel dolly truck is placed over one of the pneumatic pit jacks and raised up to the wheels. The wheels are raised off the track and the two rail sections are removed which allows the wheels to be lowered into the pit. The truck and wheels are then run along the bottom of the pit to the track which leads to the wheel lathe. The rail sections over this track are removed and the wheels raised above the track level and then the rail sections replaced. The wheels are then lowered and rolled out on the wheel lathe feeder track. This arrangement provides a quick method of removing and replacing wheels.



Pair of steel wheels can be machined on this lathe and placed on the outbound track in 25 min.

A short distance from the drop pits is a blacksmith forge which is completely tooled to handle any kind of repairs which may require a blacksmith. A skilled blacksmith is assigned to this work but since he does not have enough work to keep him busy throughout the day, he helps the general repair gang.

Method of handling wheels

The decision to install a wheel lathe at Hoboken terminal was primarily based on economic considerations. Prior to the installation of the wheel lathe all wheels to be turned had to be transferred to Kingsland, N. J., which is about 7 miles from Hoboken. This operation tied up a considerable amount of wheels and kept cars out of service longer than was necessary, besides the expense involved in moving the wheels between these points. It was figured that the expense involved in transferring the wheels to the distant point plus the capital tied up in extra wheels,

kept on hand for repair work, would pay for a wheel lathe in a comparatively short time. In other words, it was more economical to bring the tool to the work instead of the work to the tool.

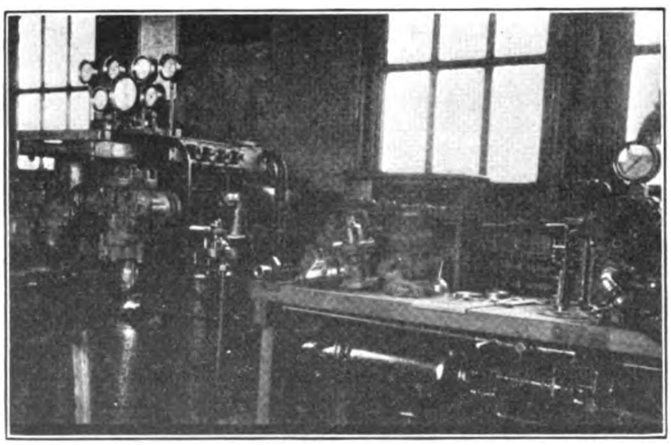
As a result a Sellers wheel lathe, capable of turning steel wheels, was installed. This lathe is housed under a shed which is approximately 60 ft. from the center line of the drop pits. There are two tracks leading to the wheel lathe, one for wheels waiting to be turned and one for turned wheels. These tracks each hold about 15 pairs of wheels. Just at the end of these two tracks and directly in front of the wheel lathe, is a 2-ft. 2-in. dolly truck, which is shown in the accompanying drawing. The distance between the axle centers in 7 ft. 6 in., in between which are fastened two sections of 75-lb. rail, 2 ft. 8 in. long and located 15½ in, from the center of each axle, which makes the distance between the rails 4 ft. 8½ in.

The lathe is placed on a concrete foundation sufficiently below the ground level so that a pair of wheels can be rolled to the lathe and readily placed on its centers by means of an overhead air hoist. After the wheels are turned, they are placed on the dolly truck and moved to the outbound track. By means of this arrangement a pair of wheels can be rolled into the building, placed in the lathe, turned, removed from the lathe and rolled out on the finished wheel track in 25 min.

If a pair of Pullman wheels is needed in a hurry, a reverse movement can be made. The wheels can be run down the outbound track to the wheel lathe, thus avoiding moving all the wheels on the feeder track.

The short distance over which the wheels have to move from the drop pits to the wheel lathe, coupled with the dispatch with which the wheels are handled in and out of the lathe, have reduced the amount of extra wheels on hand to a minimum and delays to cars waiting for wheels to zero.

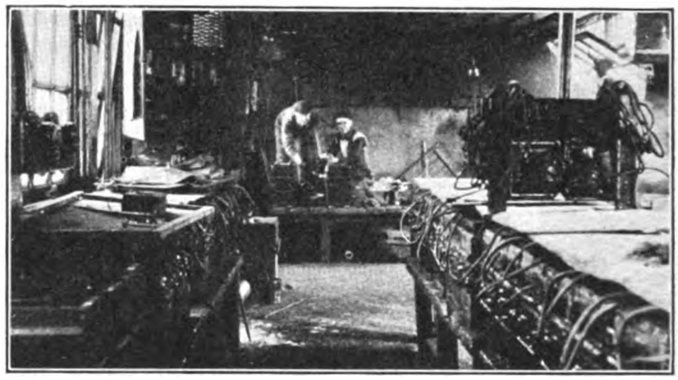
Another advantage obtained by the location of this lathe at the terminal is that a close check can be kept on steel wheels in order to have them turned in time for use in freight service. In the past 36-in. steel wheels worn below the 1-in. limiting mark were scrapped. The A.R.A. rules now permit the use of these wheels in freight service, as there still remains ¼ in. of wearing metal which will give from three to four years of freight service. Full advantage is being taken of this ruling of the A.R.A. at Hoboken with the result that many steel wheels are being diverted to freight service.



U. C. and triple valve testing racks located in air brake room

Maintenance of air brake equipment and steam heat

The majority of the passenger car equipment at this terminal is of steel construction and equipped with the U. C. brake equipment. The schedule for bringing the cars in for cleaning has been so arranged that the U. C. equipment is due for cleaning at the same time. This is an advantage, as the cars can be placed over a pit for the removal of the U. C. equipment, which makes it much easier for the repairmen to remove them because of their heavy weight. Westinghouse test racks for U. C. and triple valves are in the air brake room, which is located in a building adjoining the coach cleaning shop and the repair pits. These test racks should be located at the terminal as considerable expense and time is saved over the practice of sending air brake equipment to be tested at the back shops, which are usually a considerable distance from the terminal. Furthermore, this arrangement keeps the air brake equipment down to a minimum. All air brake governors, reducing and steam heat valves are repaired in the air brake room.



Batteries from all the cars running into Hoboken are repaired in this shop

Battery and car lighting maintenance

The batteries of all the cars running into Hoboken terminal are repaired in the battery repair shop, which is 14 ft. wide and 35 ft. long, and located directly beneath the air brake room. Six men are assigned to battery maintenance, four in the repair shop and two outside inspecting and making minor repairs. The batteries are removed from all the cars sent to the shops for general repairs and repaired and replaced when the cars come from the shop. A battery is removed from a car, torn down, rebuilt, tested and replaced in the car in 33 hr. time, which is considered a good repair figure. From 100 to 125 batteries are given a general overhauling in one year.

A gang of seven men is assigned to car lighting maintenance. They inspect and make minor repairs on the generators and the general lighting system. This force has become thoroughly familiar with the car lighting equipment and is able to locate and remedy trouble in a short time. Repair parts are kept at a minimum. Uniform results are obtained as routine inspection periods are made covering the whole equipment.

Method of cleaning cars in the yard

Considering that there are about 850 car arrivals every day at this terminal, considerable work must be done in the yards and in the train shed. One of the big jobs is the dry wiping of these cars every day. The work is done by gangs in charge of a gang leader. The arrival and departure of the trains have been analyzed so that these gangs can move from one train to the other with a minimum loss of time, the heaviest work being done during the longest layover. This arrangement is essential as all the cars must be wiped once a day, most of which is done on a piece-work basis. The cars are wiped with waste

which was used in the coach cleaning shop for the final polishing of the cars. This leaves a certain amount of the emulsion cleaner on the waste which helps to remove the dirt and polish the cars. The exterior of the cars are dry wiped, except in rainy weather, when they are washed.

Every suburban car is swept, dusted and mopped and the water cooler iced and filled daily. The water coolers are also steamed weekly. Repairs are made to all the hardware and other minor defects which can be quickly repaired.

The plush seats of the suburban cars are vacuum cleaned once a week and the main line cars once a day. This is accomplished by means of a vacuum system which is piped throughout the terminal and in all the offices. Two-inch pipe is used, from which an outlet is taken every 75 ft. The vacuum for this system is maintained by two vacuum pumps each driven by a 40-hp. Westinghouse induction motor. A vacuum of 21 in. is maintained at the plant with one vacuum pump. All the offices at the terminal are cleaned with vacuum cleaners.

Results obtained at Hoboken

The facilities and the organization described in this article were planned to achieve certain definite results. The primary object was to increase the length of time between shopping periods of passenger equipment, without deterioration to the cars and without sacrifice of a favorable general appearance of the equipment. In doing this the number of cars passing through the general repair shop every month would be reduced and thus the working force eventually reduced. The length of time out of the shop for D., L. & W. passenger cars has been increased from 12 to 18 months or over. Thus, if a shop had to give general repairs to 1,200 cars, it would have to handle 100 cars a month on a 12-months shopping basis and on an 18-months shopping basis would have to handle 66 cars a month. The saving effected is obvious.

The results of receiving periodical emulsion cleaning give a more general uniform appearance of trains which reacts favorably to the traveling public.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Work necessary to justify the charge for cleaning air brakes

On February 27, 1923, the Charleston & Western Carolina cleaned the air brakes on N.O.T. & M. car No. 750 for which it rendered to the Gulf Coast Lines a bill for $5.17. The Gulf Coast refused to pay the bill on the grounds that the work had not been performed according to Rule 60 effective January 1, 1923, the second paragraph of which provides that the charge is not permissable for cleaning the triple valve unless the triple valve cylinder, retaining valve, dirt collector or pipe strainer are all cleaned at the same time. The items listed on the repair card indicated that the dust collector or pipe strainer had not been cleaned. The Charleston & Western Carolina stated that car No. 750 was not equipped with a dirt collector but was equipped with a strainer made solid in the train line tee at the branch pipe connections. It could not be cleaned or become dirty, as dirt or scale would go straight through the strainer and the train line and could not get into the branch pipe. The repairing line also contended that circular D.V. 276 was issued to cover this particular feature.

The Arbitration Committee rendered the following decision: "The charge in question is sustained, in accordance with Circular D.V. 276, dated April 28, 1923. At the date of the repairs, there was no requirement that the billing repair card should show that the car was not equipped with a centrifugal dirt collector."—*Case No. 1325, Gulf Coast Lines vs. Charleston & Western Carolina.*

Car damaged through lack of rider protection

The C. B. & Q. furnished a joint inspection statement, dated July 14, 1923, which contained a list of defects existing on C. & W. C. car No. 3074, and requested disposition under A. R. A. Rule 120. The handling line did not advise the circumstances under which the damage occurred. Later, the C. B. & Q. advised that the C. & W. C. car was damaged in switching service without rider protection. As a result of this admission on the part of the handling line, the car owner declined to authorize repairs, as the damage was the handling line's responsibility under Rules 143 and 120 and Rule 32 Section D, Item 4. The handling line contended that ample evidence had been furnished the car owner that its car had been damaged in fair usage on a practically level track where no rider protection was necessary. The car owner contended that even though the switching took place in practically a level yard, the fact that the impact of two cars coming together broke six sills on its car, indicated that rider protection should have been provided.

The Arbitration Committee rendered the following decision, "The handling line is responsible for the damage to this car as per Rule 32, Section (d), Item 4. Case 1224 is parallel."—*Case No. 1331, Chicago, Burlington & Quincy vs. Charleston & Western Carolina.*

Charge for testing and adjusting safety valves on tank cars

During the months of October and November, 1923, the Shaffer Oil & Refining Company tested the safety valves of 17 cars belonging to the Johnson Oil Refining Company. Each car was equipped with two safety valves. Bills were rendered against the car owner for this work with a labor charge of four hours per car, two hours for adjusting the valves to a 20-lb. pressure and two hours for the testing. The labor charges were assessed according to A. R. A. Rule 107, Items 288 and 288B. The car owner returned the bills to the repairing company for correction stating that only two hours labor should have been charged for each car in accordance with A. R. A. Rule 107, Item 288B. The car owner stated further that the testing and adjusting should be considered as one operation as safety valves must be tested after being adjusted to show that they have been adjusted correctly. The repairing line contended that the two operations were separate, inasmuch as the valves were removed from the car and put on a test rack. If the spring is properly adjusted to 25 lb. pressure, the valve is considered O.K. If not properly adjusted, the valve has to be removed and the spring adjusted until it releases at 25 lb. This makes it necessary to take the valve off and on several times to make the proper adjustment.

The Arbitration Committee rendered the following decision: "The contention of the Shaffer Oil & Refining Company is sustained."—*Case No. 1328, Johnson Oil & Refining Company vs. Shaffer Oil & Refining Company.*

One day's output—Eight completed cars

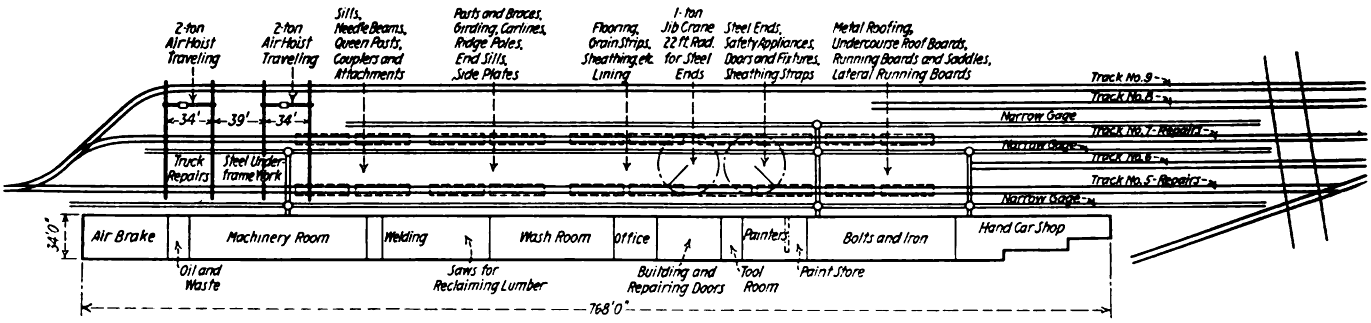
Burlington rebuilds eight box cars a day at Aurora

Successful application of station-to-station method and production system has resulted in increased output

At the Aurora, Ill., car repair shops of the Chicago, Burlington & Quincy an extensive application of the station-to-station method has been in operation for several months which has two features of unusual interest: First, the fact that the station-to-station method has been successfully applied to a rebuilding operation where the cars are not completely dismantled and, second, a simple production system which not only increases the earnings of the men engaged but serves as well to speed up production. Work on this program was started on November 25, 1924, and, up to April 2, 1925, with two rebuilding tracks working, 681 cars had been completed.

The cars being rebuilt are 40-ft., 80,000-lb. capacity box cars with wood superstructure, side and intermediate sills and steel center sills. In the rebuilding operation they are fitted with two-piece corrugated steel ends and metal roofs.

The present rebuilding operation is carried on on two parallel tracks with identical work being performed at adjacent locations as the cars are moved from station to station. The output averages four cars per track for each working day, a total of eight finished cars per day. By this method a car is completed and ready for service at the end of the fourth day from the time it is placed on the stripping tracks.

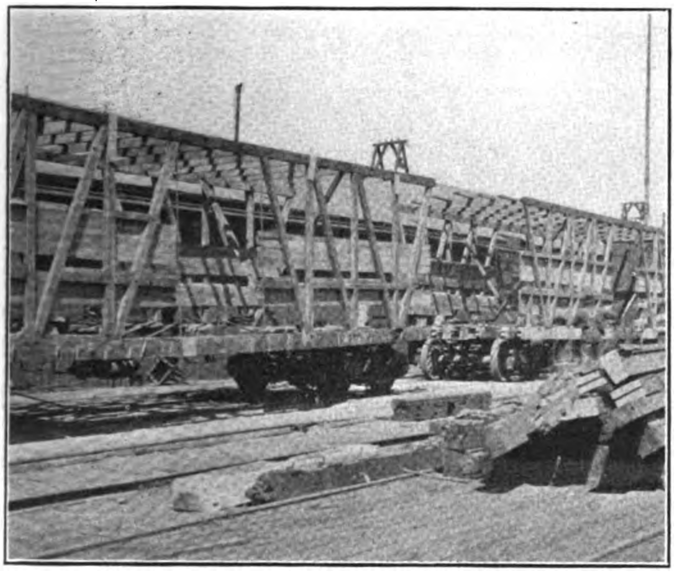


Layout of repair tracks showing the location of the different stations

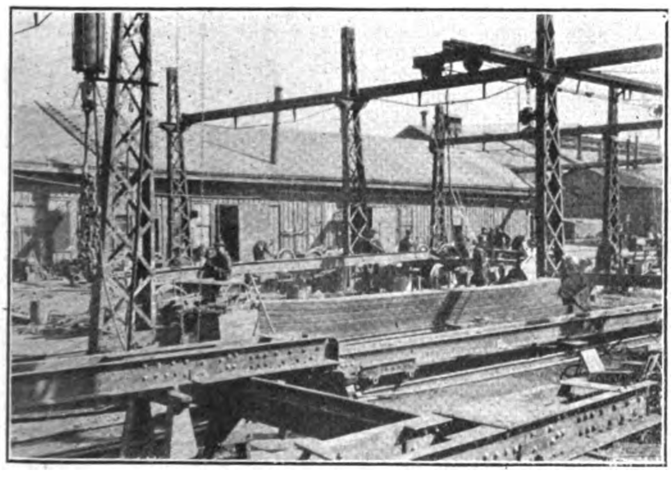
At the present time the average force employed on the entire stripping and rebuilding operation consists of 146 men classified as follows:

25 helpers and laborers on stripping tracks.
82 freight car repairers on the two rebuilding tracks.
1 steel car repair man } On truck channels.
1 steel car helper
13 steel car repairmen } On repairs to steel center sills.
6 steel car helpers
2 steel car repairmen } On fabrication of steel ends.
4 steel car helpers
3 air brake repairmen.
5 painters.
3 door men.
1 car oiler.

Before putting this repair system into operation a careful study was made of the various operations and the time required for each and a schedule was prepared providing a fixed time allowance for each operation. The total time allowance for all operations required in complete stripping and rebuilding program is 203½ man-hours per car. At the present time the work has progressed and been systematized to such an extent that the average time per car has been reduced to approximately 144 man-hours. A production system is in effect whereby if a gang is able to complete their particular operation in less than the time allowed by the schedule it results in a proportionate increase in the amount paid them for that particular operation. This system is remarkably simple and efficient in operation. The fact that it is possible for one man to keep all of the time records of the total force employed in connection with the complete rebuilding operation is an indication of the simplicity of the time and production system. The production feature functions in such a manner that if a gang on a certain operation is able to complete that operation on a number of cars within a given period in less time than the schedule allows, they are paid at the rate of the allowed time per car for the actual number of cars completed. For example: Suppose on a certain operation two men were allowed 1 hr. 30 min. per car and their hourly rate was 62 cents. They are actually able to complete their operation on 12 cars in 13½ hrs. However, they would be paid for 12 cars at the allowed time of 1 hr. 30 min. each, or a total of 18 hrs. at the hourly rate of 62 cents. In this manner their hourly rate for 13½ hours would be actually increased to 82.6 cents.

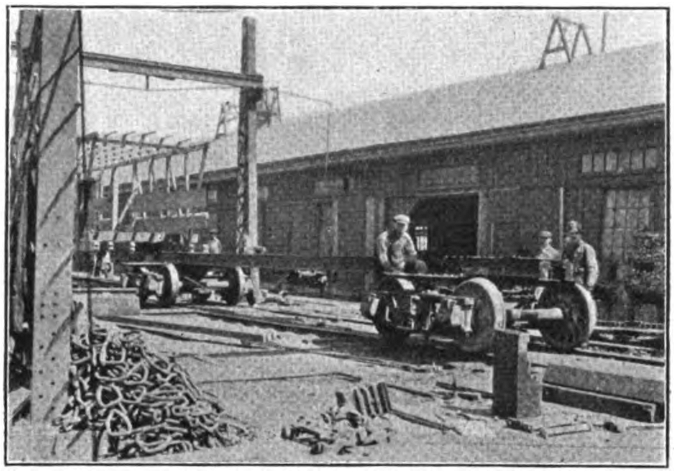


Stripping operation completed—Ready for rebuilding



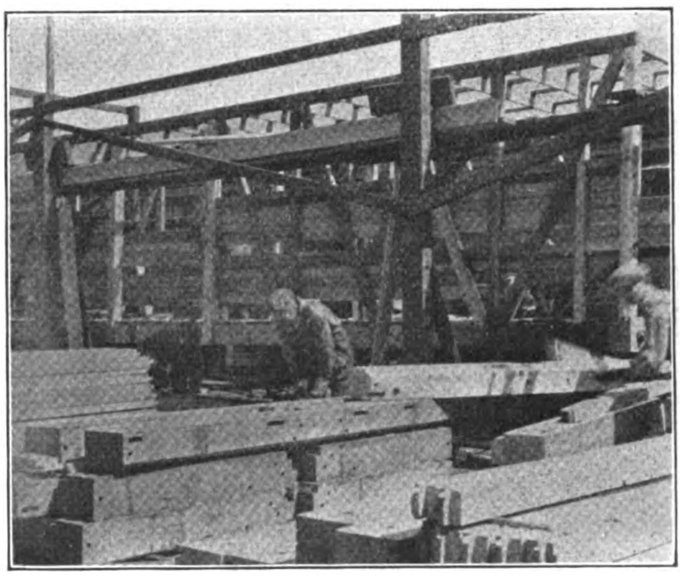
Truck and steel center sill repair station showing overhead cranes

The fact that the rebuilding operations are conducted on parallel tracks sets up a spirit of friendly rivalry between adjacent gangs at the different stations and this has enabled a substantial reduction in the time required to complete the rebuilding of a car as well as a general increase in the earnings of the men.



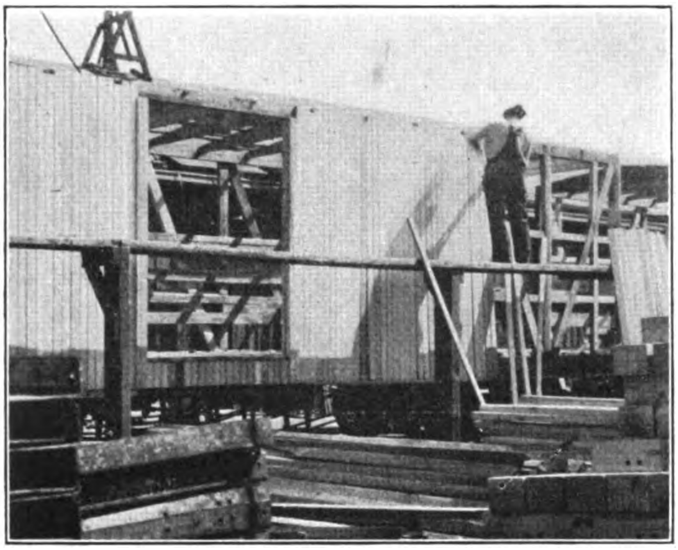
Trucks and sills repaired and ready to be returned to car

In general, a given number of cars to be rebuilt are placed on the stripping tracks each morning. After the stripping operations are completed the cars are moved by tractors and placed two at a time on each of the two rebuilding tracks. The first rebuilding operations consist principally of the jacking up of the car body and the removal of the trucks and steel center sills for repairs and the application of cover plates. An interesting feature of this operation is the manner of removal of the trucks and center sills from two cars at a time. Both cars on one track are jacked up and after the trucks and center sills



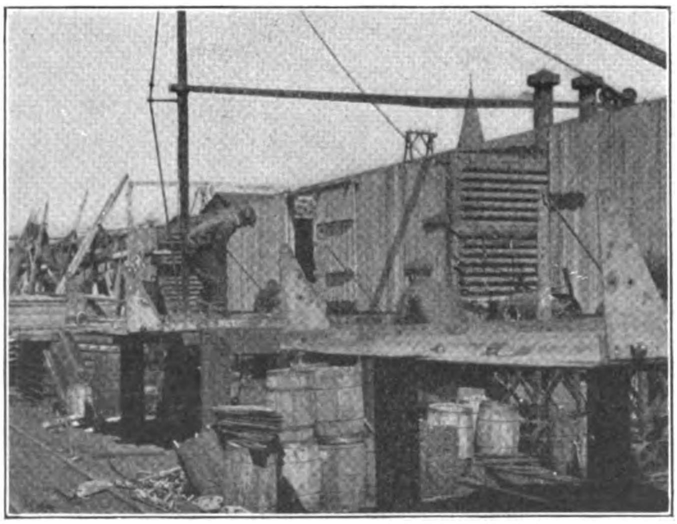
The framing of the car completed

are run out from under the car nearest the truck repair station the trucks and sills from the second car are removed from under the car and follow the first set, passing under the first car on the way to the truck repair station. Overhead crane service is provided at the truck and steel center sill repair station and the air brake repair and test room is located adjacent to this station. When the work at this station is completed the car is moved to the next station where the work on the body framing, flooring and sheathing, etc., is carried on. Adjacent to this station is the door shop where three men turn out an average of 16 complete side doors and 16 running board



Framing completed—Applying the side sheathing

extensions each eight-hour day. The fabrication and application of steel ends is also made at this location. From here the cars are next moved to the stations where all roof work is completed and from there to the stations where the first and second coats of paint are applied and finally all stencilling is done and final inspection made.



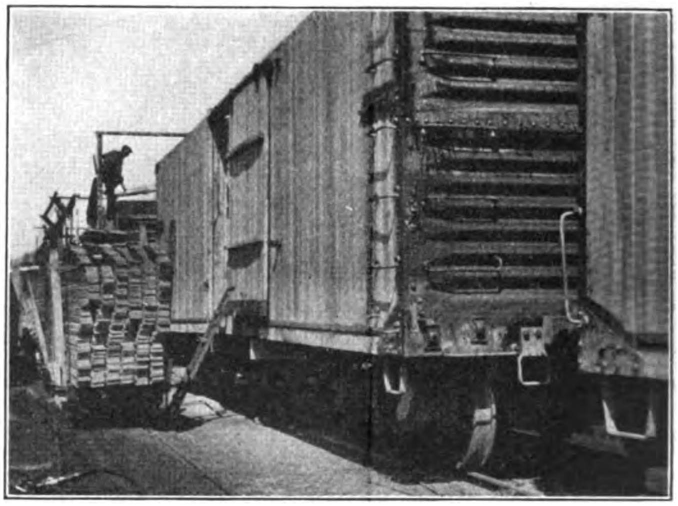
Fabricating the steel ends

Rigid inspection is also made at the completion of each operation.

The general layout of repair facilities makes it possible to effect an unusually economical scheme of material distribution. Material for the various operations is concentrated at each station, a separate gang checking material at all times and providing material from the main storehouse, car machine shop, blacksmith shop, and mill to replace that which is used. Tractors with trailers and trucks on narrow gage tracks are used to transport this material.

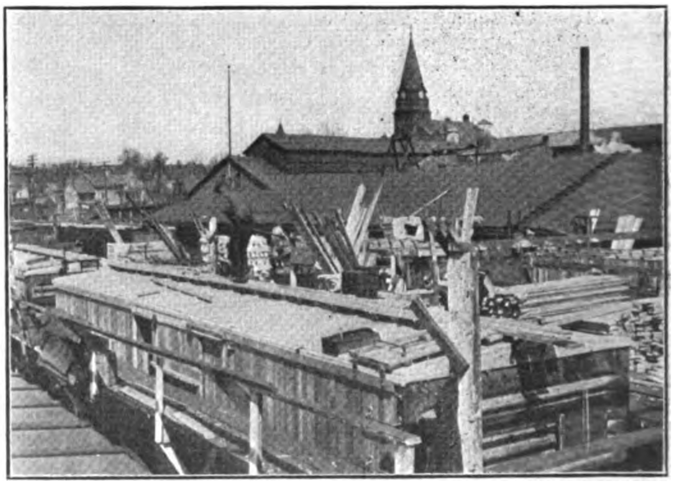
Details of operations at each station

Position No. 1—Stripping—Operations: Remove running boards and roof, brake shaft castings, all fascia, side and end doors, door



Car body completed ready for moving into position where roof is applied

tracks and fillers, door brackets, front and back stops, corner plates, grab irons, sill steps, sheathing and sheathing straps, corner end and side door posts, end plates, tie rods and buffer lugs, door lintel strips, nailing strips, necessary flooring, lining, grain strip and girth, threshold plates, cleaning nails from all framing not removed and the preparation and bracing of car for moving.



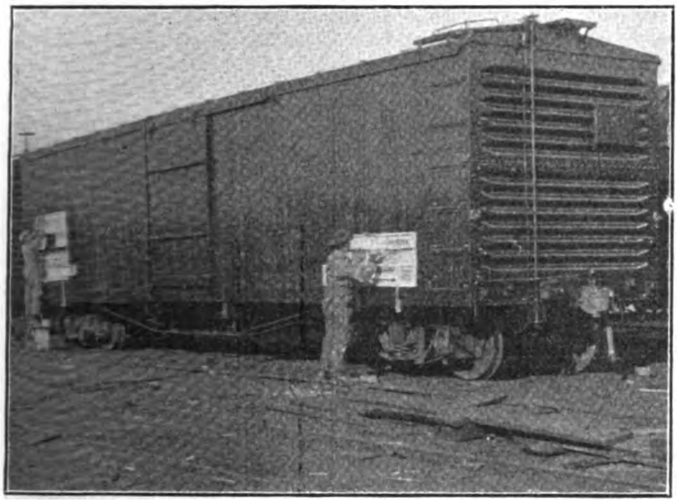
Roof repair position—Note elevated platforms and material

Remove box and column bolt nuts, end sills, buffer blocks, couplers, pin lifters, brake step, turnbuckles, truss rods, needle beams, body bolsters, all brake connections, pipe clamps, release rods; drive up post rods when side sills are to be removed and apply the necessary cleating of posts and braces.

Position No. 2—Rebuilding—Operations: Jack up car and remove trucks and steel center sills. Remove and replace side sills, intermediate sills or splices. Remove and replace truss rods, bolt truss rod saddles to sills, frame old needle beams, remove and replace lever carriers, floating levers and brake rods, air cylinder, needle beams and castings; replace trucks and steel center sills and body bolsters and jack car body down.

Position No. 3—Rebuilding—Operations: Tear down trucks and rebuild complete, including channels, bolsters, arch bars, springs, journal boxes, brasses and wedges, wheels, brake beams, brackets, hangers and pins, levers, bottom rods, brake shoes and

keys and dust guards. Men at this position assist in removing trucks and steel center sills from under the car and help take combined steel sills off the trucks, apply couplers, followers, springs, friction castings and tie castings. They also assist in replacing trucks and steel center sills under the car. Spring channels are also repaired at this position by a separate gang of two men.



Painting finished and ready for stenciling

Position No. 4—Rebuilding—Operations: Straighten steel sills; apply cover, lap and gusset plates, body bolster and truck center plates, needle beam clips; line up broken sills and apply channel patches. Remove and replace draft castings and body bolsters. Cut up scrap sills, and do all necessary burning, bolting up, reaming, heating and driving rivets. The men assist in handling steel sills off and on trucks.

Position No. 5—Rebuilding—Operations: Apply end sills, corner posts and lugs, side door posts, intermediate posts and side braces, end and side plates and rods, carlines and anchor lugs, purlines and ridge pole, renail old purlines, tighten carline lugs, sill steps, sheathing girth, ladder posts, anchor rods for steel ends, carline and ridge pole bolts.

Position No. 6—Rebuilding—Operations: Apply and nail side sheathing complete. Apply and nail flooring, complete.

Position No. 7—Rebuilding—Operations: Apply side doors, side door stops, open door stops and blocks, door brackets, tracks and fillers, door hasps on stops and doors, side plate door headers, grab irons, brake step, sheathing straps, side plate anchor rods, uncoupling levers. Bore holes. Adjacent to this position is the door shop in which three men are employed on side doors and running-board extensions.

Position No. 8—Rebuilding—Operations: Rivet metal ends together including the application of gusset plates. Apply metal ends. Bore holes and apply bolts through middle and bottom gusset plates; intermediate tie rods, apply truss rod nuts, turnbuckles and block and tighten up. Apply buffer blocks, carry irons and end sign boards.

Position No. 9—Rebuilding—Operations: Apply side and end lining. Bolt nailing strips to steel ends, post strips, grain strips, lining blocks, clean nails off inside the car and apply threshold plates.

Position No. 10—Rebuilding—Operations: Apply metal roof complete including all filler battens, longitudinal running board, running board extensions, brake shaft and bracket, saddles and brackets, side and end fascia. Apply all washers, lock nuts and nuts on all roof bolts inside the car, lay bottom course diagonally, set nails, end plate tie rods: straighten car, bore holes and apply bolts in top gusset plates and end plates.

After all rebuilding operations are completed the cars are given two coats of paint by the spray method and all stenciling is done. When this is completed final inspection is made and the cars are ready for service.

Hand brake power for freight cars

A discussion of the recommendations contained in the report of the A. R. A. Committee on Brakes and Brake Equipment

By Robert H. Blackall

THE recommendations contained in the report of the Committee on Brakes and Brake Equipment of the American Railway Association, Mechanical Division, which was made at the convention held at Atlantic City, N. J., June 11 to 18, 1924, were ordered submitted to letter ballot of the members. The letter ballot circular, No. D. V.-375, was mailed at Chicago, October 18, 1924, and the ballot was closed on November 18, 1924. It was recommended by the committee that the hand brake wheel or hand brake ratchet lever, brake staff at the chain, and the hand brake leverage between the brake staff and cylinder shall be so proportioned that a force of 125 lb. at the rim of the brake wheel of three inches from the outer end of the hand brake ratchet lever develop an equivalent load W at the brake cylinder piston of not less than 2,500 lb. and 3,950 lb., respectively, for cars having 8-in. and 10-in. cylinders. Inasmuch as the views of the writer, which are based upon practical tests with the dynamometer, do not coincide with the results assumed in the report, a discussion of some of these results and various points connected with the subject in general may be of interest.

According to the formulas given in the report, the pull on the chain at the brake shaft would be $W = \frac{125L}{r}$ in which $r = M + K$. M is the radius in inches of the brake staff drums, and K, the distance, in inches, from the face of the brake staff drum to the center line of the brake chain.

The instructions in the report, using a 7/16-in. brake chain as shown in Fig. 1, give $K = \frac{1}{2}$ in. Using the brake shaft drum shown in Fig. 2, $r = 1\frac{1}{4}$ in., $L =$ the diameter of the brake wheel, or the distance from the center of the shaft to the end of the ratchet lever, and $W =$ the work performed.

Referring to Figs. 2, 3, 4 and 5, it will be seen that the distance from the center of the shaft to the center of the chain is $1\frac{1}{4}$ in., 1 9/16 in. or $1\frac{3}{8}$ in., according to how the chain happens to be winding on the drum at the time of full application. This maximum difference is but 5/16 in., yet in an actual dynamometer test it will be found that, with one man, there is often a considerable variation which is accounted for principally by this difference in the distance from the center of the shaft to the center of the chain.

The instructions in this report assume that the center of the hand is 3 in. from the outer end of the lever, which distance approximates a hand 6 in. in width. As a matter of fact we believe this distance is more nearly 2 in.

With a dimension of 19 in. from the center of the shaft to the end of the lever, and subtracting 3 in. as directed,

we would have 16 in., or the same as the value L for a 16-in. diameter brake wheel. On this basis the value for the ratchet lever referred to in the report would develop a chain pull exactly the same as with a 16-in. brake wheel, which is not borne out by dynamometer tests.

If the method suggested of taking 3 in. off of the distance from the center of the shaft to the center of the lever is followed when using a 28-in. club, we will have, referring to Fig. 6, practically the same condition as we would have with a lever 20 in. long.

If this method of reasoning holds good, it is equivalent to saying that practically no more braking power can be obtained by the use of a 28-in. club than with a wheel alone, which we know is not the case.

A test was made on May 10, 1920, with three brakemen in the presence of seven observers, most of whom were engaged principally in office work. The results of this test are shown in the table, from which it will be seen that the maximum chain pull obtained with a 16-in. wheel was 1,280 lb. against an average of 1,098 lb. Using a 28-in. club on a 16-in. wheel a maximum pull of 2,400 lb. was obtained by one of the brakemen, the average being 1,930 lb. A maximum chain pull of 2,500 lb. was made by the writer with an 18-in. leveraged ratchet and the average was 2,084 lb. With a 24-in. leveraged ratchet the maximum chain pull was 2,700 lb., which was also obtained by the writer, and the average was 2,308 lb.

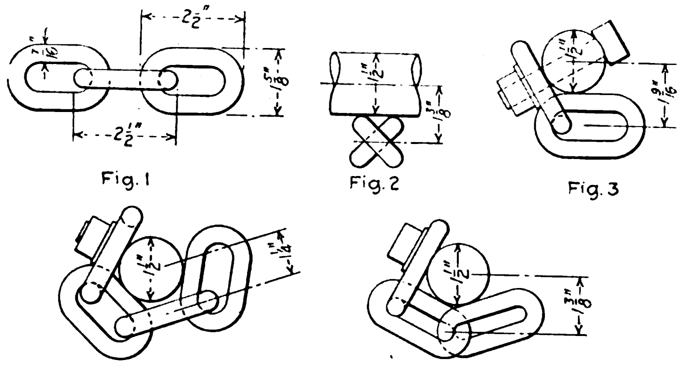


Fig. 1 Fig. 2 Fig. 3

Fig. 4 Fig. 5

Drawing showing different windings of the chain around the brake staff drum

It will be noted that the use of the formulas recommended by the committee give a value of 1,600 lb. for the 16-in. wheel whereas the maximum chain pull in this test was 1,280 lb. and the average 1,098 lb.

According to the formulas the ratchet having 19 in. from the center of the shaft to the end of the lever should have given a pull of 1,600 lb. whereas the maximum was 2,500 lb. and the average 2,084 lb.

In studying this table it will be noted that there is a reading given for both maximum and "dog," and that the variations in these readings vary all the way from 200 lb. to 700 lb. The average pull was approximately 300 lb. The maximum reading means the greatest pull that was obtained in each test and the "dog" reading refers to the amount to which the chain pull dropped back when the shaft was allowed to revolve backwards until the pawl or "dog" engaged the ratchet wheel. This emphasizes the necessity for having as large a number of teeth as possible in the platform ratchet commensurate, of course, with the strength.

The minimum number of teeth used at present for new equipment is 16 and it would seem that it would be working towards greater efficiency of the hand brake to make this number 25. The writer has seen this number of teeth in a gear and it had ample strength. Another interesting point developed by this test was that instead of having a shieve to double the power of the chain pull, this pull was never within 10 per cent of the theoretical doubling that was supposed to result and it was sometimes less.

From data resulting from dynamometer tests it would seem correct to use in the formula an average pull at 2 in. from the end of a lever as 170 lb. and at the edge of a brake wheel as 100 lb. and the average distance from the center of the shaft to the center of the chain as $r = 1\frac{1}{4}$ in.

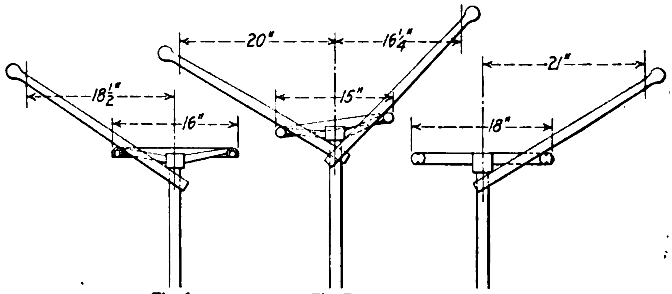


Fig. 6 Fig. 7 Fig. 8

Drawing showing the various lengths of leverage obtained with a 28-in. club on 16-in., 15-in. and 18-in. hand brake wheels

There has been considerable agitation for the use of a booster in connection with the hand brake. Several devices placed on the market are quite ingenious and most of them will do exactly what is claimed for them with the slack in the brake rigging a predetermined amount. However, the pull does not always remain constant when this slack varies. The great objection to practically all boosters is the initial cost and the fact that as long as a brake wheel is used, the club will be used also. This means excessive braking power on these cars and trouble will result if the strength of the brake step is figured only for the power developed by the wheel and booster. It also has to withstand the power developed by the use of a brake stick.

The following example can be cited in order to show that this conclusion is not theory. About 1904, the writer designed a gear multiplying mechanism which was placed on about 1,000 ore cars. After this gear had been in use for some time it was found necessary to use a short leverage ratchet so as to prevent the brakemen from using a club on the hand wheel. Trouble was experienced afterwards because of friction in the gears when the end of the car bulged. The final result was that all of these boosters were removed and replaced by a ratchet which gave a predetermined amount of power.

Straight Pull On Chain		Meyers	Coulter	Peck	Courtney	Blackall	Clark	Emery	Straight	Peden	Taylor	Average
	Wt	175	162	146	180	173	135	150	160	178	150	161
16" Wheel	Max	1280	1100	1100	1000	1100	1200	1000	1100	1100	1000	1098
Only	Dog	1040	900	800	800	760	560	760	900	840	800	816
16" Wheel	Max	2200	1800	1800	1600	1900	2000	1400	2200	2400	2000	1930
28" Club	Dog	1500	1480	1400	1440	1400	1700	700	1500	2100	1400	1462
Ratchet	Max	2400	1800	2000	1600	2500	2240	2100	1900	2300	1800	2064
18" Lever	Dog	2100	1500	1500	1600	2000	1600	1700	1600	1760	1600	1696
Ratchet	Max	2400	2100	2400	2000	2700	2400	2440	2200	2240	2200	2308
24" Lever	Dog	2000	1300	2200	1500	2300	1800	2200	1920	2100	1900	1922

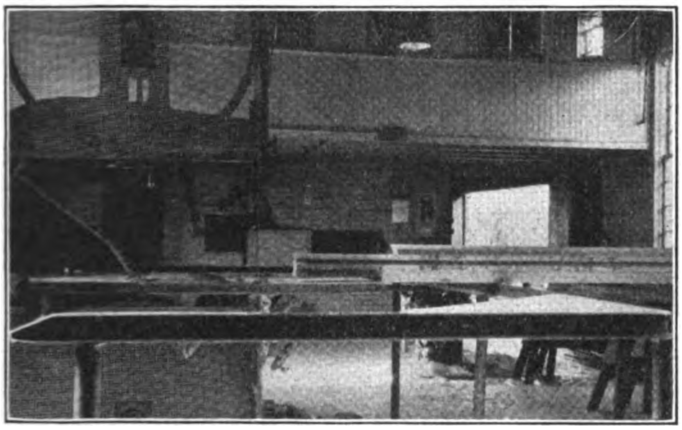
Table showing the maximum chain pull obtained in tests on various types of hand brakes

If the committee desires simply to establish an arbitrary method of figuring the hand brake power, it would seem advisable to employ the results of a dynamometer test as a basis. The formulas give too low a chain pull for all but the brake wheel, and this is too high. The lower the brake chain power the greater the necessity for multiplying this power in order to obtain the same chain pull as that developed by the air brake with 50 lb. cylinder pressure. The result will be more chain to wind up and there is hardly sufficient room at present for the chain to be taken care of properly. Because of this it would seem advisable to approximate more nearly the actual power applied at the rim of the brake wheel or to the end of the ratchet lever and thus get an efficient hand brake with a minimum amount of chain to be taken care of.

It will be of interest to note that the horizontal distance or leverage, of a 28-in. club as shown in Fig. 6 is 18½ in. This is the same as a ratchet lever having a distance of 20½ in. from the center of the shaft to the end of the lever and taking off 2 in. for the distance back to the center of the hand.

Cutting large pieces on a band saw

PRACTICALLY every wood shop has occasion at some time to cut large pieces of lumber on a band saw. The carpenter usually finds it somewhat difficult to perform such work as notching side posts and diagonal braces at the ends, for box and refrigerator cars on a band



A rail placed at the same height as the band saw provides additional support for large pieces

saw of the ordinary type without using a horse or trestle to hold up the other end. Quite often the side post or diagonal brace falls off the horse while the notch is being cut and breaks the saw. The arrangement shown in the illustration has been devised so that long pieces may be readily handled on a band saw without any possibility of accident due to the overhanging end falling off a trestle or other support. It consists essentially of a light rail bent as shown and placed at the same height as the table of the band saw. Triangular shaped filler boards are placed in each corner so that the operator may swing the work to any position desired without liability of it falling down inside the rail as it is swung around a corner. There is sufficient clearance between the rail and the table to allow plenty of room for the operator to handle small pieces. Another advantage in having such an arrangement is that a truck can be placed along side of the rail and each piece can be moved endwise across the rail to the saw and cut with a minimum amount of lifting and handling.

Device for cutting out holes in dust guards

THE usual practice in cutting the holes in dust guards is to chuck the guard on the face plate of a lathe and feed the tools to the work. The method used for doing this work at the Kingsland car shops of the Delaware, Lackawanna & Western is the reverse; i.e., the cutting tools are mounted on the face plate and the dust guard placed in a suitable holder and fed to the tools.

The method of mounting the tools in the face plate

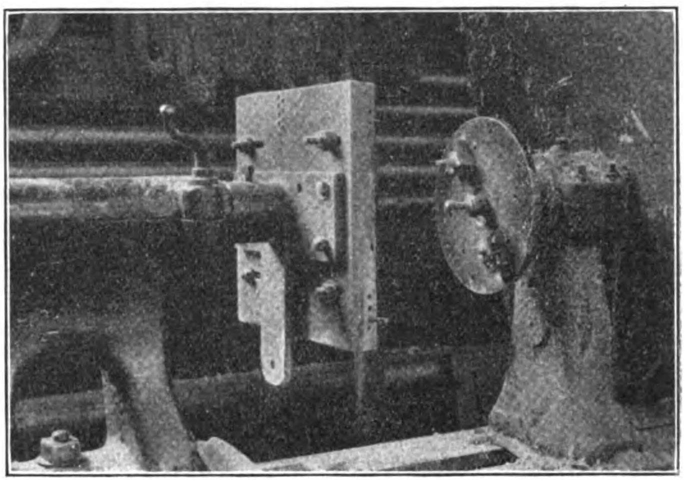


Fig. 1—Arrangement of adjustable cutting tools on the face plate of a lathe

is shown in Fig. 1. The tools are ground to a width of ¼-in. and placed in the toolholders which are adjustable for the purpose of cutting any diameter of hole required for any size of axle. The piece cut from the dust guard is pushed from the hole by a device extending from the lathe spindle. Its primary purpose is to warn the operator that the cut has been finished and that the dust guard should be set back to prevent the tools from digging into

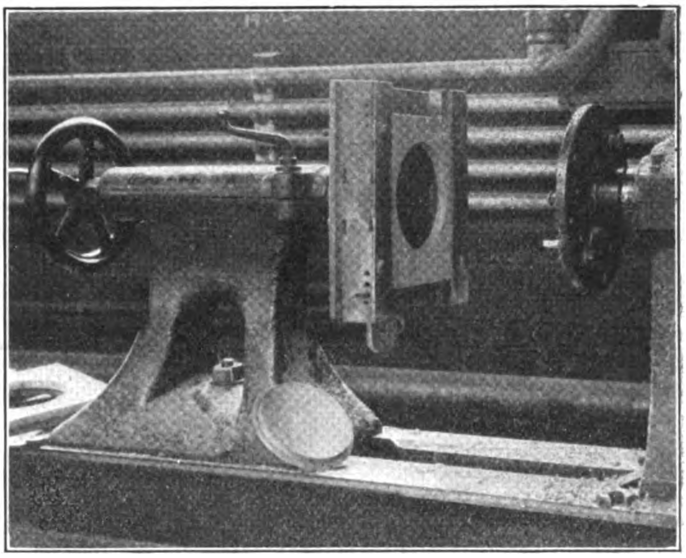
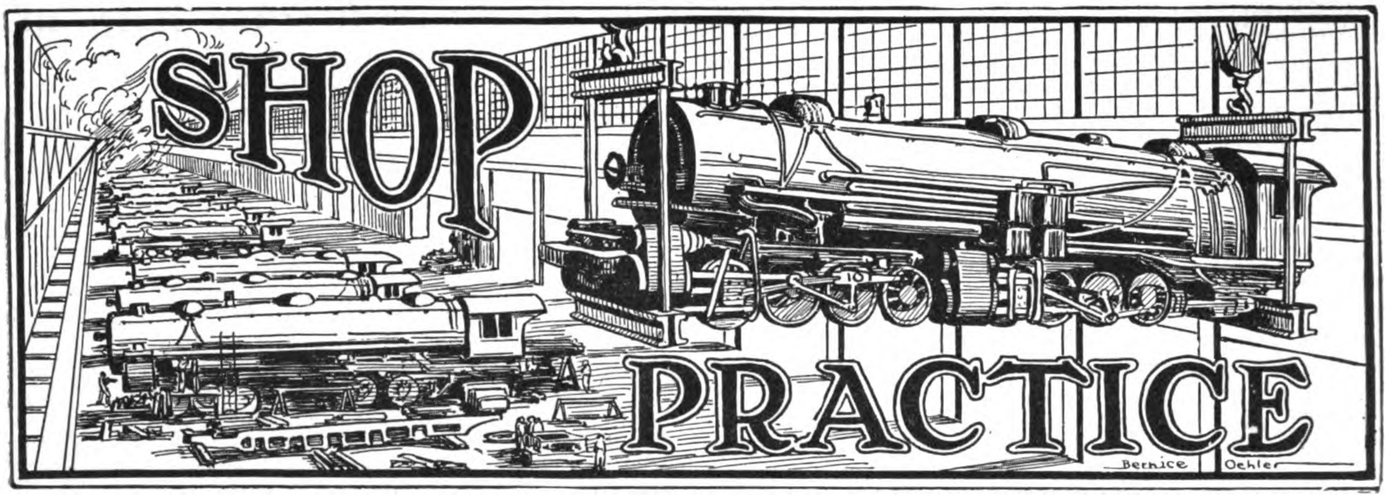


Fig. 2—Adjustable holder for holding various sizes of dust guards

the rear of the dust guard holder. The device consists of a bolt which fits in a bushing and has a nut and washer on one end and a spring at the other.

Fig. 2 shows the method of holding the dust guard. With this arrangement dust guards can be machined with great rapidity. The actual time to complete one piece is 45 sec.



Booster inspection and maintenance

Instruction of enginemen in handling boosters and close attention to lubrication are important maintenance factors

THE locomotive booster has proved an important factor in the increased utilization of the steam locomotive. Like many other appliances found on the modern locomotive it presents a new and somewhat different maintenance problem. A study of this problem on some of the railroads which have a large number of boosters in service brings to light the fact that the real solution of the booster maintenance problem lies in the prevention of trouble, rather than in the repair of the equipment.

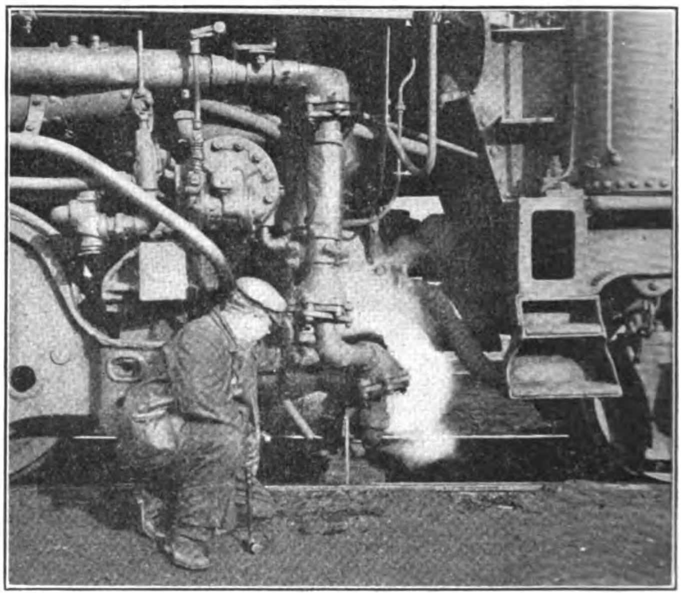
The Lehigh Valley, particularly, has been successful in the operation of booster equipped locomotives, and has 60 in service at the present time—50 Mikados in freight service and 10 Pacifics in passenger service. Two facts stand out rather prominently in studying the conditions on that road, viz.: first, that since the first booster was placed in service in March, 1923, there has not been an engine failure which could be charged to the booster and, second, that not one of the 60 boosters in service has yet been dismantled for a general overhauling. Some of these booster equipped locomotives have made more than 100,000 miles and the majority have made from 35,000 to 50,000 miles.

It has been found that the most successful way in which boosters may be maintained is to provide a separate organization to look after this work. Consequently, at each engine terminal where booster locomotives are cared for there has been assigned one machinist whose principal duty is to look after the booster equipment. These men are responsible for inspection and maintenance and render reports to the chief locomotive inspector, a system officer.

Much of the success of the Lehigh Valley in the operation of boosters may be attributed to the fact that when the first booster equipped locomotive was placed in service on the road, a great deal of stress was placed on the importance of properly instructing the men. As a consequence, classes were instituted in which special instruction pertaining to booster operation and maintenance was given to traveling engineers, enginemen and shop men. The traveling engineers made up the first classes of instruction in order that they might qualify to act as instructors of the enginemen.

Inspection

When a locomotive reaches the terminal at the end of its run, a thorough inspection of the booster is made while on the pit. While it may appear to be relatively unimportant, the first thing done by the inspector is to clean



A convenient method of checking the height of booster cylinder cocks

off, with an air hose, all of the coal and ashes that may have accumulated on top of the booster casing. This not only serves to make the top of the booster casing readily accessible in case it is necessary to remove the crank case cover for any reason, but it also lessens the possibility of dirt and ashes working into the mechanism.

The second step is to close the idler cock and idle the

booster engine. While doing this the inspector makes a careful inspection of all parts of the booster to make certain that there are no oil leaks. One of the principal points at which oil leaks occur is where the booster engine piston rod passes through the casing frame. There is an end cover plate here in which a ⅝-in. round packing is used as a wiper to prevent the loss of oil. This packing frequently becomes worn or deranged so that it is important to renew it if necessary.

While the booster engine is being idled, the inspector observes whether it is running at normal speed, to determine whether or not the preliminary throttle valve is functioning properly. While the inspection of the booster equipment is being made, it has been found advisable to set the independent brakes on the locomotive to prevent any possibility of the locomotive being accidently moved. The cut-out cock to the clutch cylinder is now opened and the booster latch is thrown in. This cut-out cock has been previously referred to as the idling cock, because of the fact that when it is closed the booster latch may be thrown

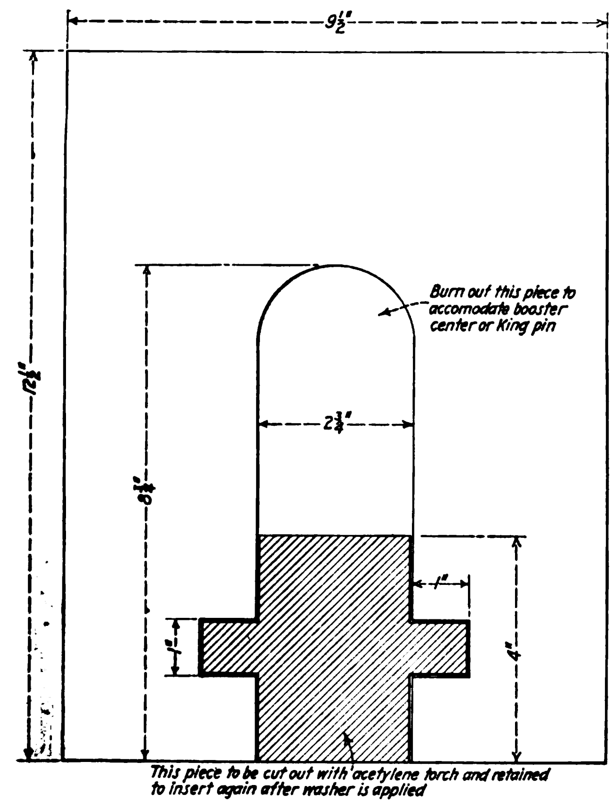


Plate washer for raising booster engine, the thickness of which can be made to suit conditions

in and the preliminary throttle valve will serve to supply steam for idling the booster engine without the clutch cylinder acting to throw the idler gear into mesh with the gear on the trailer axle. With this cock open and the booster latch thrown in the piping system to all the air control valves is filled with air under pressure so that a thorough inspection may be made with a torch to ascertain whether or not there are any air leaks in the control piping system. It is extremely important that a thorough test for air leaks be made because of the fact that a leak in the piping may cause some part of the air control system to fail to function properly while on the road.

At this point of the inspection it has been found advisable to observe the actual time required to close the cylinder cocks. Under normal operation the cylinder-cocks are automatically closed by building up pressure in the main steam inlet pipe, which acts on the main piston in the dome pilot valve. This piston, in raising, opens a small valve in the head of the dome pilot valve, which permits air to pass through the cylinder cock timing check valve and timing reservoir and causes the cylinder cock operating cylinder to actuate the closing mechanism. With the idling cock open the booster latch on the reverse lever should be thrown in and out several times to observe whether or not the main booster throttle valve is opening properly. The pet-cocks on the booster crank case should be opened to observe whether or not the oil in the crank case is at the proper level and oil should be added if necessary. The main locomotive throttle should be opened a sufficient amount to provide pressure in the booster steam line so that any possible steam leaks in the line or at the ball joints may be discovered.

The height of the booster above the rail should be measured and a plate washer applied if necessary. A clearance of five to six inches above the rail at the back cylinder cocks should be maintained in order to eliminate the possibility of any damage to the cylinder cocks from obstructions along the track. A very convenient method of checking this height has been found as follows: Directly over the rail on the inlet and exhaust manifold will be found a flat shoulder. By taking measurements it will be found that when this shoulder is 11 in. above the rail the clearance at the back cylinder cocks on the booster engine will be 6 in. One of the illustrations shows a simple yet effective method of making a plate washer to

Loco. No.__________

Lubrication				Repairs Made	
Date	Crank Case	Amt. Oil Added	Axle Bearings	Date	Description

Example of form used in keeping permanent record of booster lubrication and repairs

raise the booster engine. It is made from steel plate of the desired thickness and the crossshaped key cut out with an oxy-acetylene torch. The booster engine is jacked up to a height of at least twice the thickness of the washer and the washer inserted around the center pin. Then the key which has been cut out is dropped into the opening in the washer and the booster lowered into place. It is important that the inspector examine the cylinder cock rigging thoroughly to make sure that all parts operate freely. Enginemen's work reports frequently contain an item to the effect that the cylinder cocks on the booster do not close. Invariably this is found to be due to the fact that some of the rods on the cylinder cock rigging have become bent by striking something so that they prevent the rigging from operating freely. The full pressure and full power on the booster engine cannot be obtained with the cylinder cocks open and the importance of having them closed at the proper time is evident.

It is not only important that a thoroughly inspection be made at the end of every locomotive run, but also that an accurate record be made of each inspection. A permanent record form, which is illustrated, is kept for each locomotive, on which the inspector enters the date of inspection, a notation as to the condition of the oil in the crank case and the amount of oil added, if any. A column is provided in which the condition and attention given to the axle bearings is reported. On this form is also entered a record of any repairs which may have been made

to any part of the booster equipment. Inasmuch as these forms are made out by the booster maintenance men and inspectors at every engine terminal to which booster equipped engines are regularly assigned, the chief locomotive inspector who has supervision over this work is able at all times to know the condition of every booster on the road as well as to know what parts of the equipment require the greatest amount of attention. In this way these parts may be given special attention.

In testing booster equipment while the locomotive is on the pit, the cylinder cocks cannot be closed automatically without opening the main locomotive throttle valve, which as a general practice is not to be recommended. Therefore, in order to close the cylinder cocks manually the inspectors are provided with a small steel wedge which may be inserted under the spring seat of the upper valve in the dome pilot valve. This serves to close the valve which permits the air pressure to pass into the pipe leading to the cylinder cock timing check valve and timing reservoir and in this way the cylinder cock operating mechanism will work the same as though it was being worked automatically by the operation of the main piston in the dome pilot valve.

Opinions differ as to the proper time which should elapse after the booster engine has started to operate before the cylinder cocks close. The manufacturer recommends that a period of 20 sec. be established. But, on the Lehigh Valley, it has been found advisable to change this period of closing on different classes of locomotives to suit their particular operating conditions. Consequently, the practice has been established of setting the timing mechanism so that 10 sec. on locomotives in passenger service and 30 sec. on freight locomotives will elapse before the cylinder cocks close. The reason for this is that the booster on passenger locomotives is used only to facilitate the smooth starting of heavy trains, and consequently, it is desired to have the full power of the booster available immediately at starting. Inasmuch as a pressure of only 30 to 40 lb. can be built up in the booster engine cylinders when the drain and cylinder cocks are open, the time of closing on passenger locomotives has been reduced in order that the full boiler pressure may be available with a minimum loss of time. On locomotives in freight service where the booster is used at starting for a greater period of time it is not so important that the cylinder cocks close quickly.

Maintenance of booster equipment

Overhauling of preliminary throttle valve—Experience has proved that the greatest source of trouble in any part of the air control equipment will be found in the preliminary throttle valve and it has been found that if this valve is thoroughly overhauled every 30 days, very little trouble is experienced. A record is kept on the inspection and repair form previously referred to, of the exact date on which the preliminary throttle valve is overhauled and these records are periodically checked up to see that this work is performed at least once every 30 days. The principal operations in overhauling the preliminary throttle valve are grinding in of the steam valve, freeing the rings in the piston grooves, and a thorough cleaning and lubrication of the parts with a mixture of graphite and valve oil. Inasmuch as the practice of removing this valve at such frequent periods has been established, it has been found convenient to apply a union in the steam pipe on each side of the valve so that by breaking the joints at these unions it can readily be removed.

Throttle operating cylinder—This part of the equipment gives very little trouble and outside of a thorough examination and cleaning approximately every 90 days, very little attention is required.

Main throttle valve—The seat in this valve should be reground once each six months. In reassembling, the valve proper should be assembled in such a manner that it has freedom of movement on the valve rod. This can be assured by backing off the nut on the top of the valve rod a sufficient amount to allow the valve to adjust itself to the seat. While this work is being performed, the main steam valve should be re-packed if necessary.

Dome-pilot valve—This valve should be taken apart at least once each three months and the piston rings examined to see that they are free in the grooves. The spring should be examined to make sure that it is in good condition, and the outside valve should be ground in.

Cylinder cock operating cylinder—The piston ring in this unit should be thoroughly examined and cleaned at least every six months.

Reverse lever pilot valve—At least once each three months the spring in this valve should be examined and the inside and outside check valves reground.

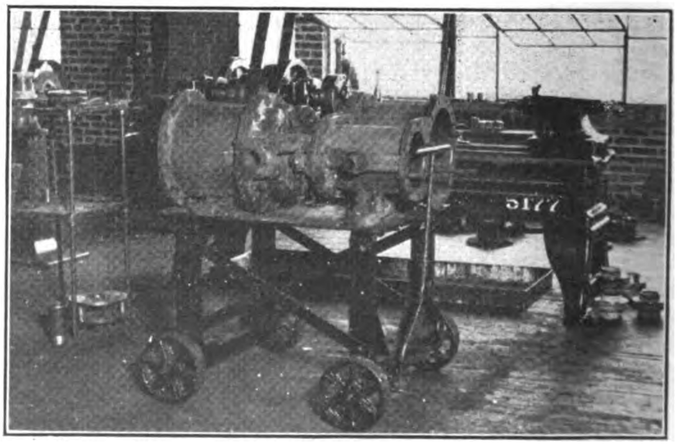
Conclusion

In considering the facts brought out by a study of conditions on the Lehigh Valley and the experience gained in maintaining booster equipped locomotives over a period of more than two years, the whole problem seems to bring out the vital importance of three factors—the thorough instruction of enginemen in the handling of the booster, proper lubrication and, finally, eternal vigilance in the inspection of boosters, together with the recording of information on inspections and repairs in such a manner that the supervisor in charge of this equipment may anticipate and prevent trouble rather than to make extensive repairs after damage has been done.

It may be well to mention the fact that the Lehigh Valley has made adjustments in the tonnage rating of all booster locomotives in order to take advantage of the full additional hauling capacity, the average increase in tonnage rating of booster equipped locomotives being about 10 per cent above that of locomotives not so equipped.

Portable bench for repairing air pumps

ONE of the numerous devices designed to expedite production in the air brake department of the Finley shops of the Southern Railway, North Birmingham, Ala.,



A portable bench designed to expedite repair work on air pumps and feed water heaters

is a portable bench used in the work of repairing air pumps, one of which is shown in the illustration. An account of the system used in the operation of the air brake department was included in a description of the Finley shops, published in the March issue of the *Railway Mechanical Engineer*.

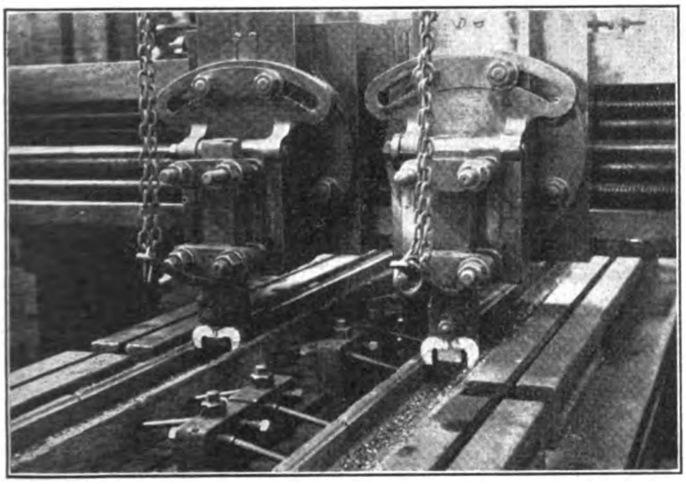
The frame of the portable bench or wagon is built of flat bar iron, securely braced to insure a rigid construction. The top is in one piece and is provided with holes so that a pump of any size may be bolted to the bench. With this bench pumps may be easily moved by the mechanic from bench to lathe and vice versa or to any other place desired. A portable bench of similar design is also being developed for feed water heaters.

Tools for planing driving box shoes and wedges

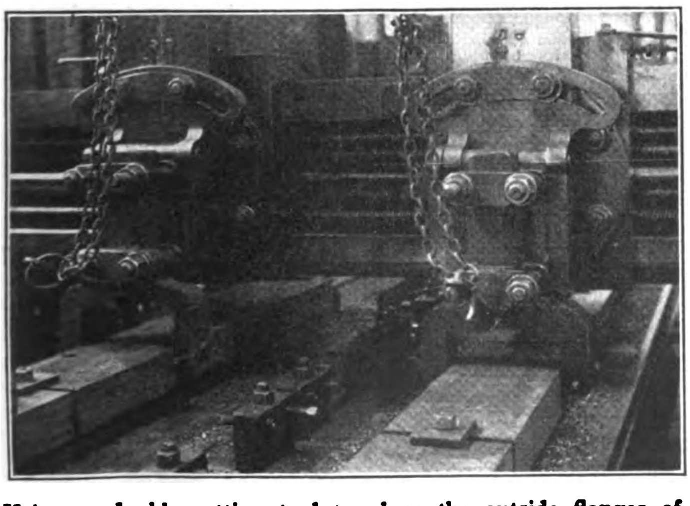
By E. A. Murray

Shop superintendent, Chesapeake & Ohio, Huntington, W. Va.

TIME and labor factors are usually the prime motives behind the development of means to improve machine operations. Such was the case in designing the tools, shown in the illustrations, which rough cut and finish shoes and wedges in two operations. After a set of castings have been laid off to driving box sizes, they are set up in two rows in a double head planer. They are first finished on the inside for the frame fit by planing down the inside of both flanges at the same time, using a double tool. The castings are then turned over, placed on a mandrel and clamped in position when both flanges are planed outside simultaneously with another double tool, which is shown in one of the illustrations.



Planing inside of flanges with a double cutter



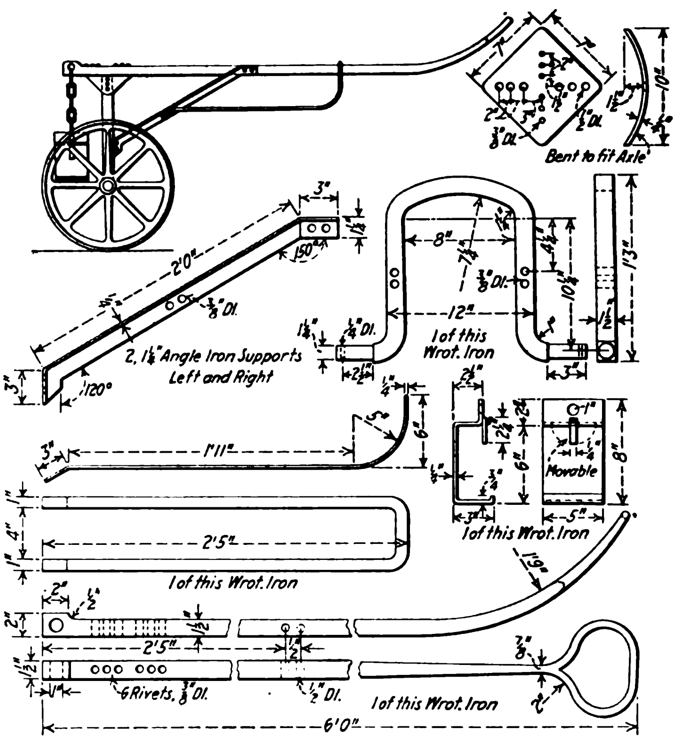
Using a double cutting tool to plane the outside flanges of driving box shoes

It will be noticed that both of these tools are made of unusually heavy material which greatly increases their weight and would naturally cause a heavy drag on the finished work on the return stroke. This objectional feature has been overcome by releasing these tools during the return stroke of the machine by the use of a pneumatic operated cylinder, which is connected to the tool post by suitable levers. The air is admitted to and exhausted from the cylinder by a lever which is connected to the reversing mechanism of the planer.

Two-wheel truck for handling rods

By E. A. Miller

A CONVENIENT truck for such work as handling rods from the blacksmith shop to the rod department is shown in the drawing. All of the parts, with the exception of the wheels, can be made in the blacksmith and machine shops. The axle is made from 1¼-in. wrought iron bar bent to the shape shown in the drawing. The handle is forged from 1½-in. wrought iron round bar and is curved up at the end so that it will be at a more convenient height for the workman. The rods are slung on a wide carrier attached by means of a chain as shown in the assembly view. A detail of the rod carrier is shown at the right of the drawing immediately above the detail of the handle. It is made of ¼-in. wrought iron and is 3 in. by 5 in. at the base with a ¾-in. lug to prevent the rod from falling off.



Drawing showing the assembly and details of a truck for handling rods

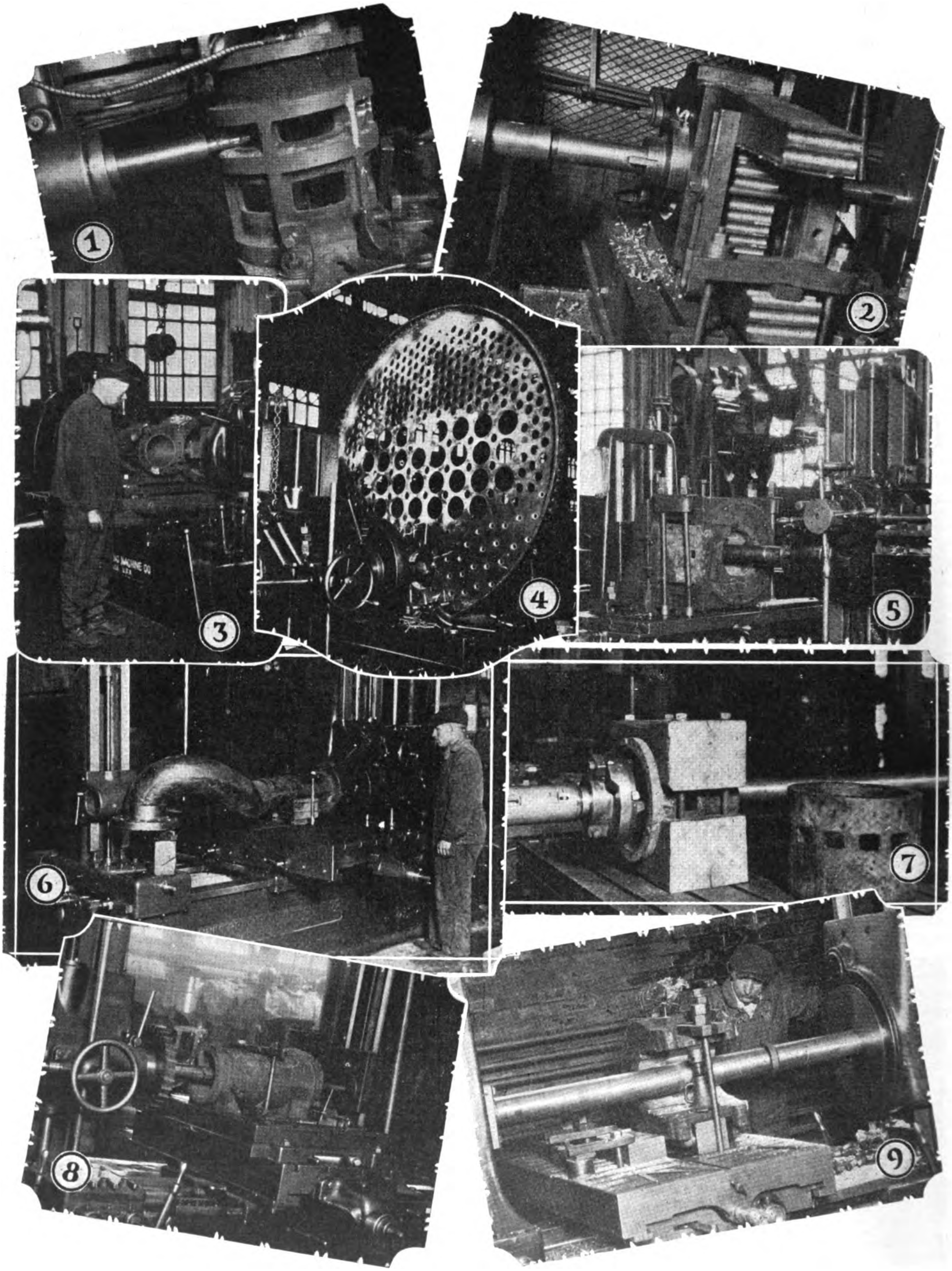


Fig. 1—Milling ports in valve bushing; Fig. 2—Boring out crank pin hole in back end main rod strap; Fig. 3—Boring cylinders of cross compound air compressor; Fig. 4—Boring out dry pipe hole in front flue sheet; Fig. 5—Boring out driving box and grease cellar in one operation; Fig. 6—Facing off branch pipe, using a facing attachment; Fig. 7—Boring out valve bushings; Fig. 8—Boring out cylinder of pneumatic pit jack; Fig. 9—Boring driving box crown brass

A versatile tool for locomotive repair shops

Horizontal boring, drilling and milling machine handles a wide range of work—Serves as a balancing medium in the shops

By Leroy R. Gurley

RAILROAD shops, particularly engine terminal shops and small back shops turning out 10 to 15 class repairs a month, handle repair work on a job rather than on a production basis. The machines in these shops are called on to handle a great variety of repair parts. These parts require many machine operations, such as boring, drilling, milling, facing, turning, shaping, planing and tapping. To provide single-purpose

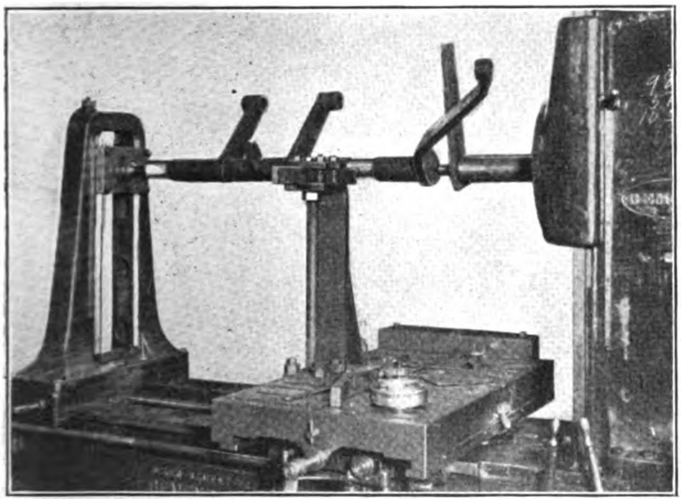


Fig. 10—Turning the bearings on a reverse shaft arm

machines for all of these operations is often impracticable. If a part to be machined requires several operations and production quantity is necessary, it is advisable to purchase a single-purpose machine for each of these operations, which would mean doing the several operations on many parts at the same time much more quickly than if all the operations were to be finished on one machine, one part at a time. But, in the small shop, where only a few parts of a kind are needed, a machine which will do as many of the operations on one part at one set-up as possible, is the most suitable.

A machine of this type is used in a somewhat different capacity in the large back shops. Owing to the fact that three different operations can be performed on this machine at one set-up it is used as a balancing machine to handle the overflow from the single purpose machines when they are crowded with work. It is also used to advantage when a regular machine breaks down. The back shops frequently have to handle large, irregular parts which can not be readily set up on the regular machines, or if they can be, it would not be practical to take the machines off from the regular repair work which they are assigned to handle. Therefore, large repair parts are assigned to a machine of this type owing to its versatility and the large platen, which is ordinarilly a feature of the horizontal boring, drilling and milling machines found in the average railroad shop.

Parts handled on the horizontal boring, drilling and milling machine

The horizontal boring, drilling and milling machine is well adapted for machining locomotive repair parts which require more than one operation. Its general design permits it to be used for machining parts at one set-up which would ordinarily require considerable trouble to set up on a single-purpose machine for but one operation.

Every railroad shop receives its share of parts such as those shown in Table I. Of course there are many parts which can be machined only on single-purpose machines regardless of the size or location of the repair shop. In examining Table I, however, it will be noted that the majority of the parts listed requires drilling, boring and milling, all three of which can usually be performed on this type of machine with one setting, and all the different cuts will be accurate in relation to each other. This elimination of the time consumed in changing the work

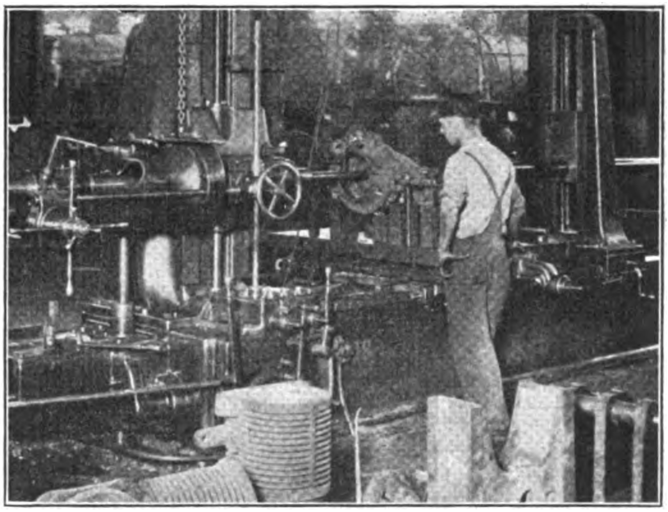


Fig. 11—Boring and facing a throttle box at one set-up

from one machine to another and the necessary resetting that would be required results in a saving in costs.

The machining of steam pipes is one of the most awkward jobs encountered in the railroad shop. Owing to its irregular shape, it is difficult to set up. Fig. 6 shows a machine of this type facing the joint of a steam pipe with the aid of a facing attachment. This effects a saving in time and labor by permitting the steam pipe joint to be faced and the flange bolt holes drilled and counterbored at one set-up. Machining crossheads is a common repair job in the railroad shop. Wrist pin and the piston fits are being faced, drilled and bored with one set-up by using

a swiveling table. Fig. 12 illustrates the method of doing this work.

Another job which the foreman dreads to see come on the floor is the turning of the bearings on a reverse shaft arm of a Walschaert valve gear, as shown in Fig. 10. In order to handle this set-up two centers were used, one to fit the taper hole in the spindle and the other to fit a bushing in the outboard support. The reverse shaft is placed on the centers and is driven with a carrier, the same as in ordinary lathe practice. The method of mounting the cutting tool, which is fed to the work by hand, is clearly shown in the illustration.

Locomotives frequently require new valve chamber bushings. This is a job which may be done at the engine terminal or at any locomotive repair shop. Part of the machine work on them requires that they be bored out and the ports milled to size. Fig. 7 shows the method

Table I—List of repair parts which can be machined on a boring, drilling and milling machine in the small railroad shop

Air compressor cylinders—boring, facing and drilling in one setting.
Air compressor center head—boring and tapping.
Bell standards—boring and drilling.
Booster engine cylinders—boring, facing and drilling.
Brasses, crown—boring, drilling and facing for lateral.
Brasses, journal box—boring and facing.
Brasses, main rod—boring, facing and milling flanges.
Check valves—boring and milling.
Crossheads—facing, drilling and boring wrist pin and piston rod fits in one set-up, using a swiveling table.
Crosshead shoes—milling.
Cylinder heads—back, guide fit—milling, one setting with swivel table.
Center castings, truck—boring.
Cellars—driving box—milling.
Deck castings, front—bored.
Driving boxes—bored, faced, filled, drilled and milled.
Eccentrics and straps—milling, tongue and groove.
Fulcrum castings—boring.
Fulcrum straps—boring.
Feed water heater cylinders—boring.
Flue sheets—boring dry pipe hole.
Gear frame, Walschaert valve gear—boring and facing.
Grate shaker cylinders—boring, facing and drilling.
Jaws, truck—milling.
Key seats, in axles—milling.
Link hanger brackets—boring, milling and drilling.
Link supports—boring.
Main rods—milling and drilling.
Tie head, steam pipe—milling and drilling.
Nozzles, exhaust—facing.
Piston rod extensions—boring, facing, turning and drilling.
Power reverse gear cylinders—boring, facing, turning and drilling.
Rocker boxes—milling and boring.
Smoke stacks—turning, facing and drilling.
Steam chest bushing—boring and milling.
Steam pipes—facing and drilling.
Side rods—boring and milling.
Stoker engine cylinders—boring, milling and facing.
Stoker troughs—boring.
Slide valve false seats—milling ports.
Slide valve steam chest—facing, boring and turning.
Straps, main rod—milling and boring.
Trailing trucks, roller seats—milling.
Throttle box—boring and facing.
Throttle standpipe—boring and facing.
Truck bolster—reboring worn pin holes.
Tumbling shafts—milling (with a gang of cutters) and boring.
Valve chamber head and valve stem crosshead guide—boring, facing and drilling.
Valve chamber bushings—milling port holes.

of boring a valve bushing, while Fig. 1 illustrates how the ports are milled to size. All the ports can be milled at one setting by means of a swiveling table.

The operations of boring and facing a throttle box are done at one setting on this type of machine, with the finished surfaces in true alinement. Fig. 11 illustrates the method of setting up the job and the boring of the preliminary lift valve seat. After this operation, the main valve seat may be faced, if necessary. Something of the use which is made of these machines is indicated by the repair parts on the floor waiting to be machined.

How the machine can be used in the large shop

In the large repair shop it is the practice to issue shop orders calling for the machining of certain parts in lots which are to be distributed to engine terminals and smaller shops. By carefully analyzing locomotive parts to be machined, it will be found that there are many requiring several operations which are not called for in large enough quantities to permit organization of the work on a production basis. Typical examples of such work is the boring of booster, stoker, feedwater heater, grate shaker and power reverse gear cylinders. These parts, some of which are too long to be handled on an internal grinder, are being finished on the horizontal boring, drilling and milling machine in number of shops. Fig. 13 illustrates the method of setting up grate shaker cylinders on a machine of this type for facing both ends,

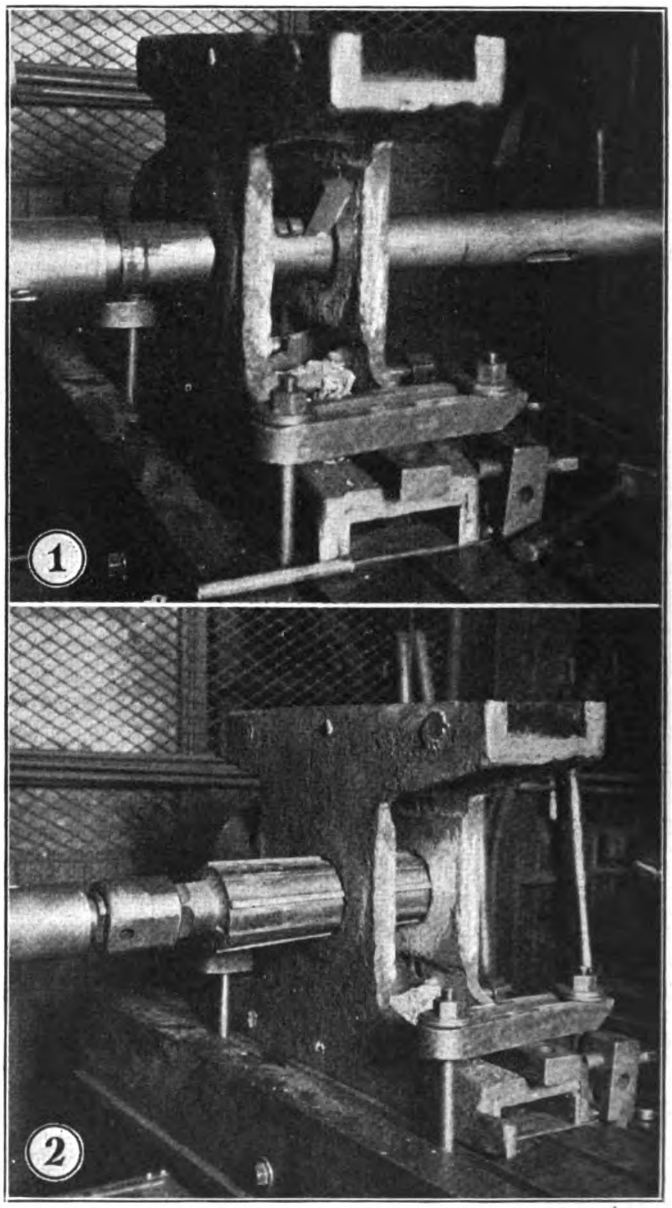


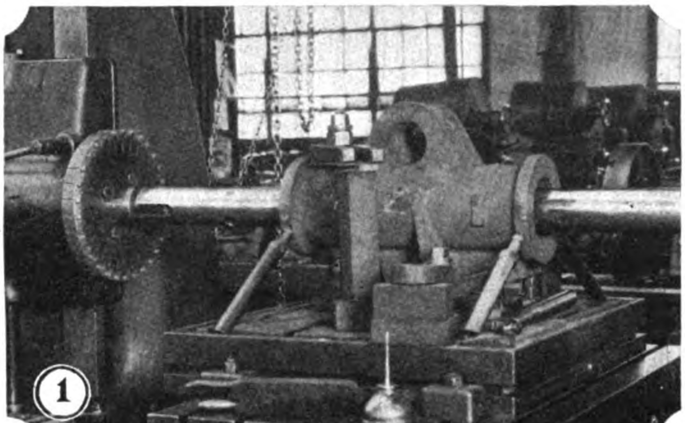
Fig. 12—(1) Facing the inside face of a wrist pin fit; (2) Reaming the wrist pin fit

rough and finish boring the cylinders and then, by turning the swiveling table 90 deg., boring the top of the casting. Steam pipe T-head jobs are also done on this machine. Fig. 14 shows a T-head being bored out and milled for the tube sheet connection at one setting.

Many other repair parts are machined in the large shops which this machine can handle effectively in single pieces or small job lots, such as valve gear frames, link support brackets, steam pipe joints, piston rod extension guides, etc. Fig. 15 shows three link brackets being bored at one set-up.

Handling the overflow from single-purpose machines

One of the important jobs of any large locomotive repair shop is the machine work necessary on driving boxes. They are generally passed through the shop on a schedule which often cannot be maintained due to the lack of sufficient machine tools to handle an unusual volume of driving boxes. The horizontal boring, drilling and milling machine is often called on to handle the overflow of work from these machines as it is capable of doing all the machine work on the boxes which the specialized tools will do. Fig. 5 shows a machine of this type machining a driving box and grease cellar at one set up. Fig. 9. shows another machine boring a crown brass, and Fig. 16 shows the milling of grease grooves in a driving box crown brass.



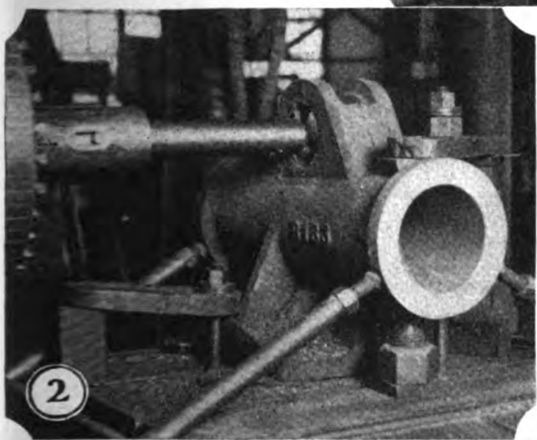
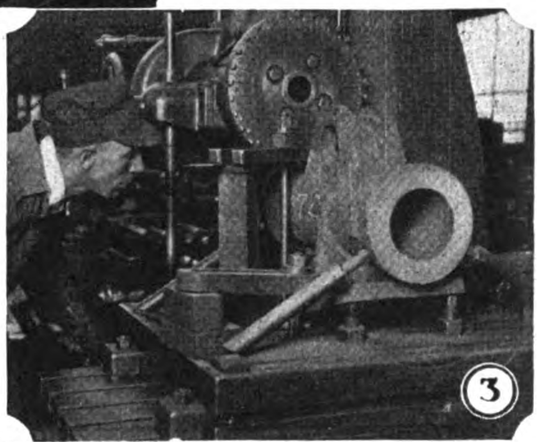
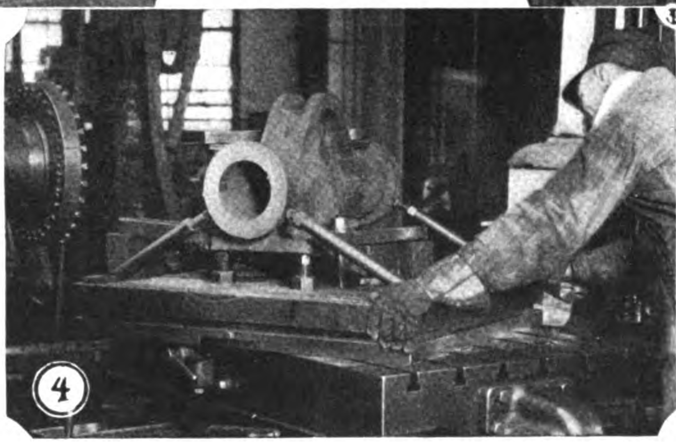


Fig. 13—(1) Boring grate shaker cylinder; (2) Boring operating shaft bearing; (3) Milling cutter facing end of cylinder; (4) Swiveling table makes it possible to perform all operations with one set-up.





An additional example of the adaptability of this machine to handle the overflow of specialized machines as well as its versatility is the milling from the solid of the back end of a main rod. Fig. 17 shows a machine of this type milling out the back end of a main rod in two cuts in 4 hr. 30 min. from floor to floor. Fig. 2 shows the same machine boring out, in three operations, the main crank pin bit of a main rod strap. Table II shows the time required to machine other repair parts on a machine of this type. The last column of the table, which shows the time to complete the work, includes the time from floor to floor.

A machine of this type in the large repair shops has been used to advantage in reboring the cylinders of air compressors. The four cylinders of a cross-compound compressor can be quickly bored at one set-up. This method eliminates time and labor required for dismantling in order to rebore the cylinders separately. Furthermore, the machining of four cylinders at one set-up assures perfect alinement of the cylinder bores. The compressor head joints can also be faced or the stud holes drilled without changing the work. Fig. 3 shows a machine of this type boring out the cylinders of a cross-compound compressor.

Unusual job handled in the large shops

The horizontal boring, drilling and milling machine is called upon to handle some unusual jobs in the large shops. Fig. 4 shows a machine boring out the dry pipe hole in a front flue sheet. This job was the result of the failure of a machine in the boiler shop which regularly handled this work. Another unusual job is illustrated in Fig. 18 which shows a machine of this type milling the keyseat in a locomotive driving axle. Fig. 19 shows a machine boring out the back end brass of a side rod, which operation requires high cutting speed due to the soft metal.

The maintenance and repair of machine tools and shop equipment leads to the machining of many jobs other than locomotive repair parts. These jobs are often cumbersome parts which cannot be readily machined on some of the other types of tools. Furthermore, the other machine tools in the shops are usually engaged in their routine operations on locomotive repairs. Thus, the versaltility of the horizontal boring, drilling and milling machine enables it readily to handle these odd jobs. The machining of air hoist and vacuum pump cylinders, the masthead of a walking crane, as well as the various parts of machine tools are examples of such work which are handled by this machine. Fig. 8 shows a machine of this type boring out the air cylinders of a pneumatic pit jack.

The place of this machine in the railroad shop

There are several factors that should be considered before placing a machine of this type in the small shop or

at an engine terminal. First, the work should be analyzed to determine whether there is enough available to keep the machine busy. The work which can be handled only by such regular machines as the lathe, planer, shaper and drill press should be first eliminated from this list. These

Table II—Time required to machine locomotive repair parts which the boring, drilling and milling machine can handle in the railroad shop

	Material	No. of operations	Kind of operations	Time to complete Hrs.	Min.
Valve chamber bushing	Cast iron	6	Milling 6 ports	1	0
Air compressor cylinders	Cast iron	4	4 cylinders rough bored for bushings	3	30
Air compressor cylinders	Cast iron	4	4 bushings finished bored complete	4	0
Side rod	Steel	7	6 roughing cuts and 1 finishing cut	2	0
Engine truck center casting	Steel	2	Reboring pin holes for bushings with two settings	0	35
Milling shoe and wedge to line	Steel	1	Milling away ½ in. of stock	0	30
Side rod strap	Steel	1	Milling to layout marks	1	0
Valve gear crosshead arm	Steel	2	Face off electric welded shoulder	0	15
			Rebore pin hole	0	10
Valve gear rod	Steel	1	Reboring pin hole	0	20
Eccentric rod	Steel	1	Reboring pin hole	0	15
Main rod	Steel	2	Milling out solid end with two cuts	4	30
Crosshead	Steel	4	Bore and ream piston rod and wrist pin fits	5	0
Trailer equalizer	Steel	2	Drilling to holes	0	36
Locomotive driving box	Bronze	3	Setting up	0	30
			Rough bore	0	6
			Finish bore	0	4
			Chamfer	0	3
Back valve chamber head	Steel	1	Reseating worn seat	0	40
Side rod bushing	Brass	1	Bored	0	10
Throttle standpipe	Cast iron	2	Bore and face throttle stem hole	0	20

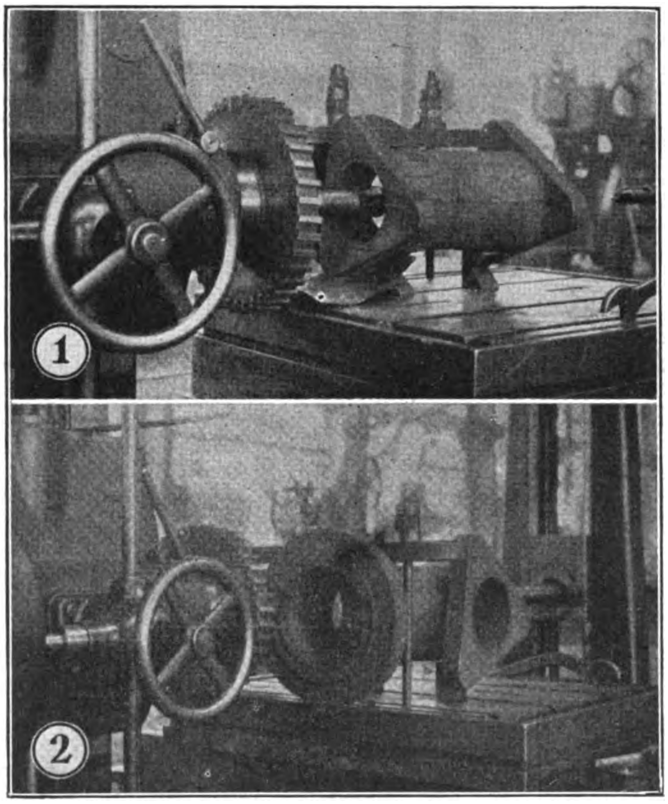


Fig. 14—(1) Boring out a T-head; (2) Facing off a T-head joint with a milling cutter—Both operations are done at one set-up

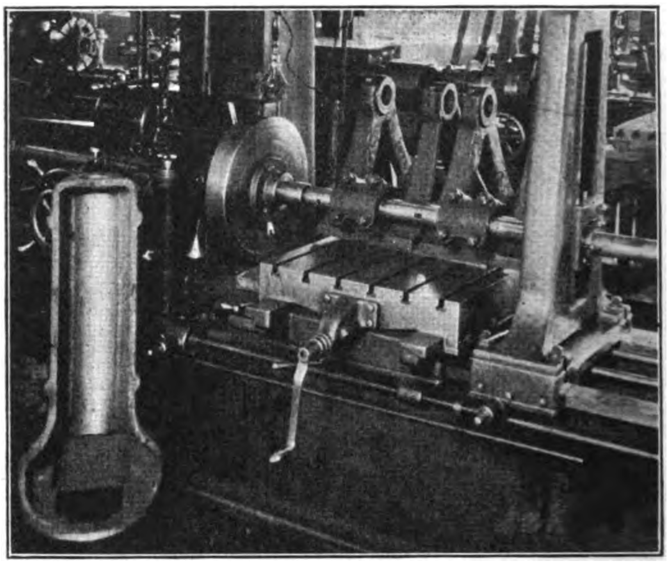


Fig. 15—Boring three link brackets at one set-up

machines are indispensable in every railroad shop. The balance of the work should be considered from the standpoint of the number of operations which can be performed at one set-up, thus saving time in transferring the work

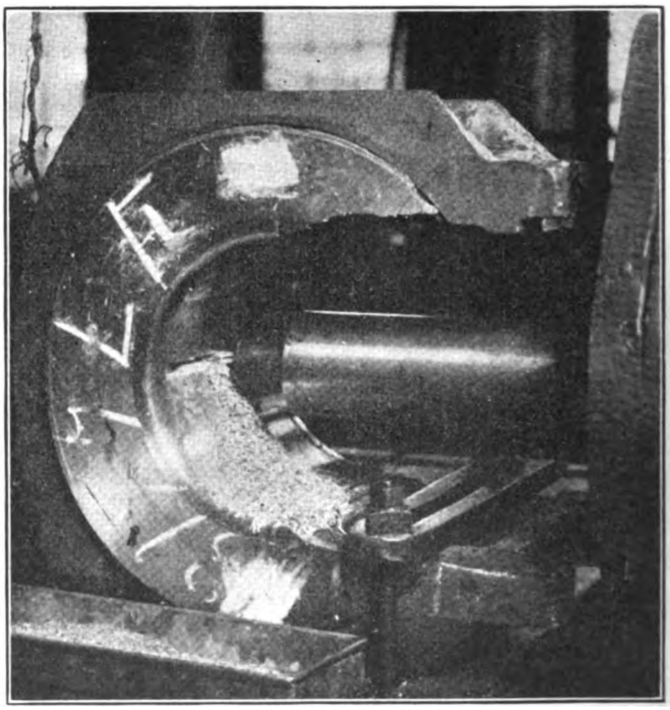


Fig. 16—Milling grease grooves in a driving box crown brass

from one machine to another. If it is found that there are enough such repair parts to keep the machine busy, then its purchase is justified. It would be a poor investment to purchase a machine of this type if it would have to stand idle a large part of the time, or be used on operations which can be performed as effectively on the single-purpose machines with which the shop is already provided.

It is well to keep in sight the fact already pointed out concerning the balancing function which this machine serves in both the larger and smaller shops. It is well to have in the shop a machine which can be used when the single-purpose machines are crowded with work or

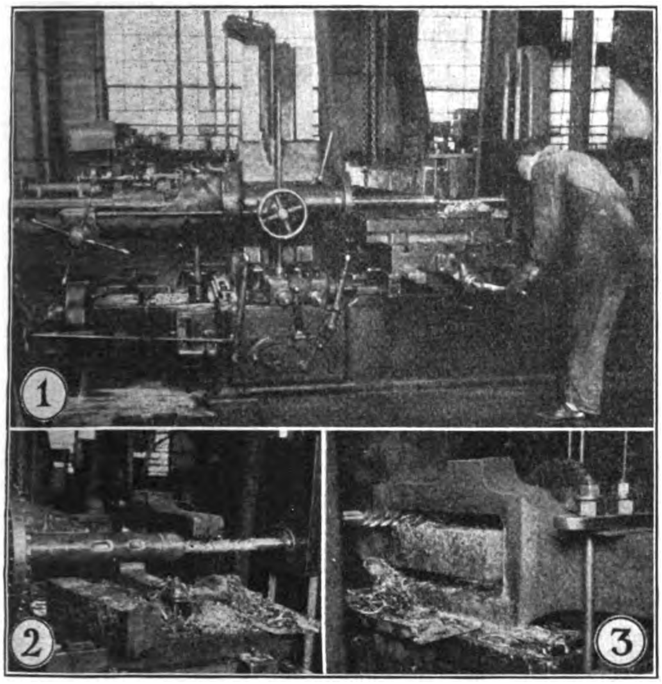


Fig. 17—(1) Starting to mill out the back end of a main rod; (2) Starting the second or finishing cut; (3) Ready to remove the block at the end of the first cut

a machine breaks down. The maximum of such protection can be provided with a minimum investment, by a multiple purpose machine, which can be used to good advantage in emergency.

The use of this machine in the large repair shops must be considered from a somewhat different angle. Repair

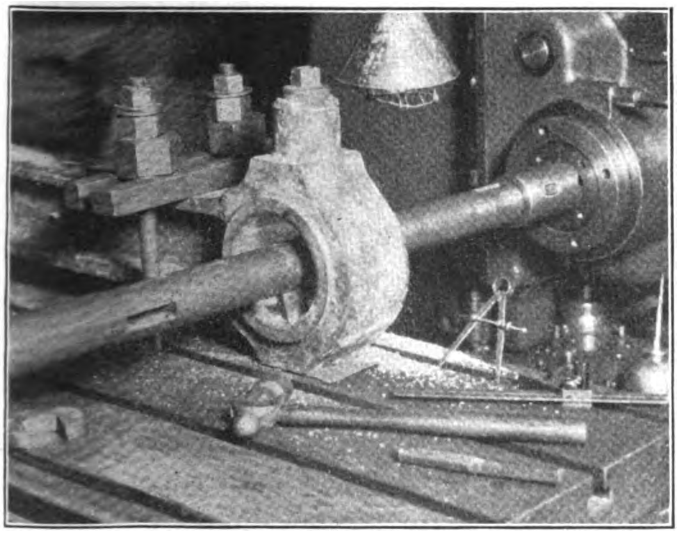


Fig. 19—Boring out the back end of a side rod brass

parts pass through the smaller shops in such limited numbers that it is not practical to install single-purpose machines to handle the work. In the larger shops the conditions are just the opposite as there are sufficient repair parts to warrant the installation of single-purpose machines. However, many parts which have more than one operation performed on them at one set-up, but which are never finished in large runs, can be machined

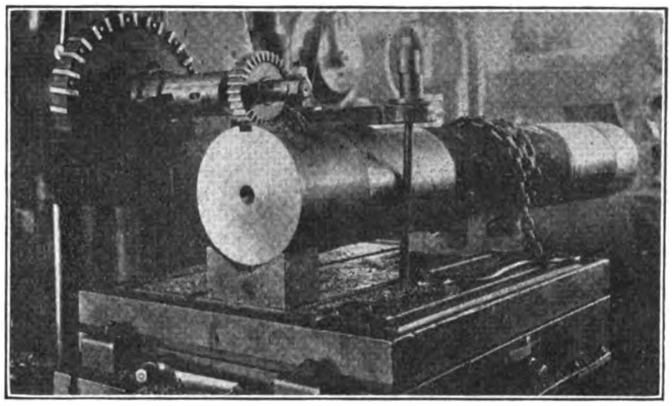


Fig. 18—Milling the keyseat in a locomotive driving axle

economically on a horizontal boring, drilling and milling machine.

Testing rack for brake cylinder packing leathers

By E. A. Miller

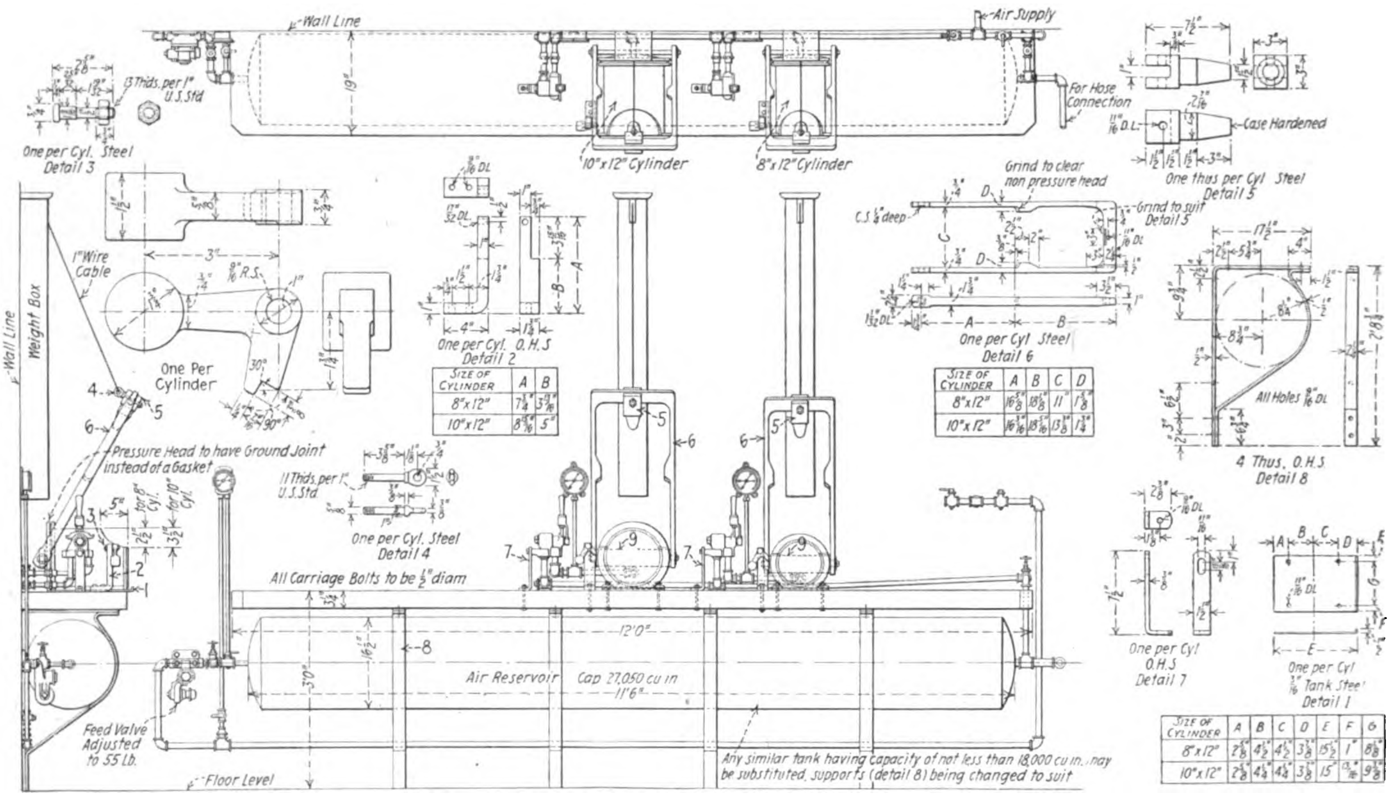
The testing of brake cylinder packing leathers is one of the essential jobs connected with the maintenance of air brake equipment. To eliminate the usage of worn and leaking leathers it is imperative that they should be thoroughly tested on a suitable testing rack. The rack shown in the accompanying illustration is apparently well suited for this work.

The equipment is placed on and under a table, 1 ft. 7 in. wide by 12 ft. long and 33 in. high, which is built against the wall. Bolted to the table are two air brake cylinders, one 8 in. by 12 in. and the other 10 in. by 12 in. whose pressure heads have a ground joint instead of a gasket. Over each cylinder is a movable yoke, which when lowered in position serves the purpose of holding the piston in place against the testing pressure in the cylinder. The yokes are counterbalanced by a weight enclosed in a tubular covering, and connected to the yokes by a 1/8-in. wire cable. Beneath the table is a 16 1/2-in. diameter reservoir, 11 ft. 6 in. long which has a capacity of 27,050 cu. in. It is charged from the main air line, in which there is a stop cock, through a feed valve which is adjusted to 55 lb. A two handed air gage, shown to the left of the table, is used; one pipe being connected to the main air line and the other to the pipe leading to the reservoir for the purpose of indicating its pressure. From the right hand end of this cylinder, a pipe leads up and back of the two cylinders on the table which supplies air to the cylinders through the back heads. A lever valve controls the supply of air and a gage is placed between it and the cylinders.

The top front end of the 8-in. cylinder is cut away 2 1/2 in. on its diameter and the 10-in. cylinder 3 1/2 in. and both cut back 5 in. on a curve as shown. This is done to permit the easy entry of the packing leather at the face and pushing it back into the increasing periphery of the cylinder until fully entered. Then it is pushed back as far as necessary to allow the yoke to be pulled down in a line with the center of the cylinder. The inside of each yoke is ground to permit it just to clear the non-pressure head and is then held in place by a latch which swings out of

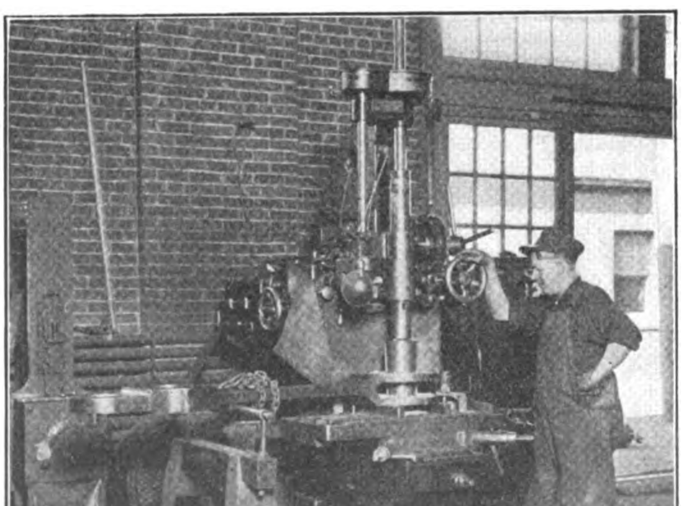
place to allow the yoke to pass and return to place due to the weight at the end of the bell crank of the latch.

After the piston is in place, the air is allowed to enter the back end of the cylinder until the reservoir pressure is 55 lb. The air is then shut off and the rate of leakage is indicated by the cylinder gage. This test being completed, the valve is opened and the air is exhausted to the atmosphere. The piston and rod are pushed back to allow



General arrangement and details of testing rack for brake cylinder packing

clearance for lifting the yoke after which the piston is quickly removed and another put in and tested. This arrangement permits the continuance of the work at a good speed.



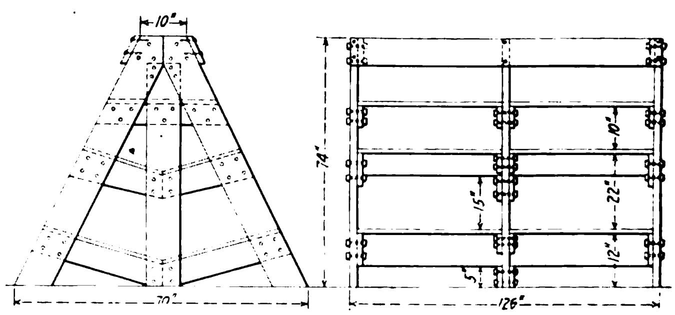
Reaming an unusually large side rod knuckle pin hole

Storage rack for arch brick

By Joseph Smith

ARCH brick piled on the floor of an enginehouse takes up considerable room and there is also danger of the bricks becoming broken, due to the piles being knocked over or bumped into with trucks and heavy tools. The rack shown in the sketch is convenient for storing arch brick in enginehouses as well as in the erecting shop. The ends and center piece are made of 2-in. by 6-in. timbers, bolted together by ½-in. bolts. Planks, which serve as shelves, are spiked to the cross pieces, as shown in the sketch.

This rack is placed in a central location in the en-



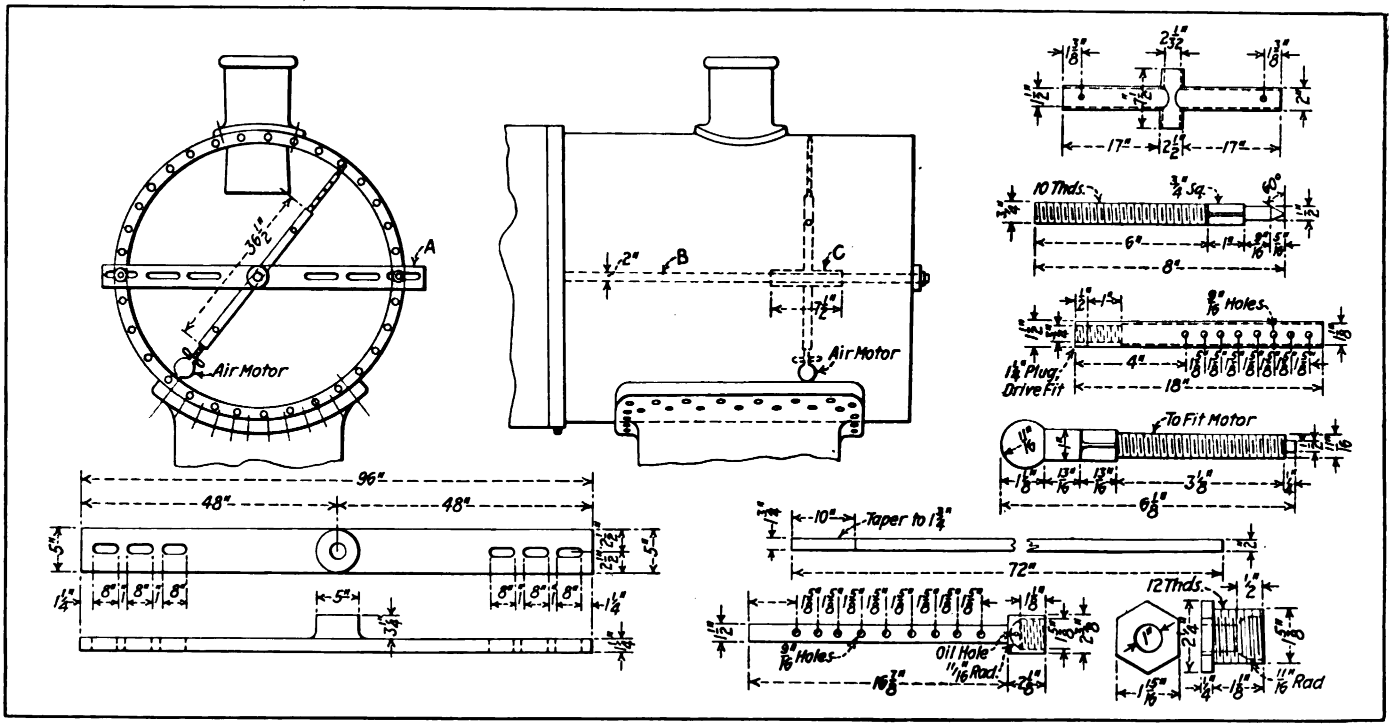
A rack for storing arch brick in the engine house

ginehouse. It will accommodate about 650 bricks of the various types and is kept supplied by a laborer. It is convenient for the hot worker and eliminates the necessity of having to go to an outside storehouse in inclement weather. As brick is taken from the rack, an order blank is filled out and placed in a metal container on the rack. These orders are periodically collected by the stores department.

Device for drilling saddle bolt holes

THE customary method of holding the air motor in position when drilling cylinder saddle holes is with an "old-man." Its use necessitates changing its position many times which requires considerable time and labor. It is often a problem to know where and how to fix or bolt it in order to drill certain holes. The device shown in the illustration does away with the "old-man" and makes the job a one-man operation.

The cross-arm *A* is fastened to the front end studs so that its center is near the center line of the boiler. Shaft *B* extends from the cross-arm to and enters the end of a flue or flue sheet hole, near the center line of the boiler. Sleeve *C* fits and slides on shaft *B*. It has two extensions, one to the motor and the other to the front end shell to act as a brace.



General arrangement and details of a device for setting the air motor when drilling saddle bolt holes

With this arrangement it is easy to swing and fasten the motor to any position thus permitting the drilling of all saddle bolt holes with one set-up. This device was developed in the Grand Rapids, Michigan, shops of the Pere Marquette.

Methods of selecting and training supervisors*

By G. P. Hodges

Division master mechanic, C. M. & St. P., Mason City, Ia.

I BELIEVE all supervisors should be selected, whenever possible, from the ranks. Of course, there always will be a time when it will be necessary to go outside for specially trained men. However, I advocate the practice of selecting your man from the ranks for it creates a better feeling with the rank and file as much depends on them to bring success to any industry. With any large railroad, it should not be difficult to find the right kind of timber for promotion to a minor supervisory position. Any supervisor who cannot find such material in his organization for promotion to a more responsible position, has neglected some of his duties as a supervisor.

A college education is not really essential, but a man should have a fairly good education, and if he is the right kind of man he will soon educate himself along the lines of his work. The late James J. Hill, once said, that he considered an educated man one that knew about all there was to know about the business he was engaged in.

The man you are considering for promotion, in the first place, should not even be considered until he has conclusively proved his ability in his former position. He must be ambitious, and a tireless worker. He should possess good judgment. This qualification is about as essential as anything else, for it is on this point that the most of us fail. If we all would think just a little more and decide to use good judgment, instead of at times, doing things without thinking of what will be the final outcome I am sure that those in a supervisory capacity could set a very good example for the men under them. Of course, I don't mean to insinuate that we don't think and use good judgment, in fact, I would be very much offended if some one stood up and told me I didn't use my head, but at the same time, we will have to admit that some of the things we do, perhaps look to our superiors as if we didn't have a head or if we have one, we didn't use it. So be sure that the young man you pick for promotion is a thinker, and thinks before he leaps. He should also have a pleasing personality, be persistent and have patience. He must also be a leader of men and must not be egotistical, as it does not work well with the rank and file. They resent egotism. As a rule, each man has to be handled just a little different. Many a man that we termed a "poor man" could have been made a "good man" if he had been handled right at the start.

As soon as I am attracted to a young man that looks promising to me, I watch him, inquire about him

*A paper presented before one of the Master Mechanics' meetings held on the Chicago, Milwaukee & St. Paul.

from the foreman, find out what kind of a citizen he is outside of the plant and, when I see him occasionally, I stop and talk to him about his work. I also try to find out if he is loyal to the company or, in other words, is interested enough in his work to be fair-minded in his dealings and will do just a little more than he is paid to do something a little out of line with his schedule. If I find him loyal as a workman, it can be generally figured that he will be loyal as a supervisor. After determining these facts, I ask him if he thinks he would care to become an enginehouse foreman. If he states that he desires to get ahead, I send him application blanks to be filled out, after which they are filed in my office, awaiting an opportunity for promotion. Of course, I do not go to extremes in this. I generally keep about four applications for enginehouse foreman and two applications for traveling engineers on file. In picking a traveling engineer if the man is a first-class engineman and thoroughly understands machinery and the air brake, then the only thing he has to prove is his ability to handle men.

We want only broad-gage men in supervisory positions. There is no place on a railroad these days for narrow men. They must be able to weigh the questions fairly, whether they involve friend or enemy, and at all times be absolutely honest in their decisions. This is the only way to get along with men and do justice to the company you work for.

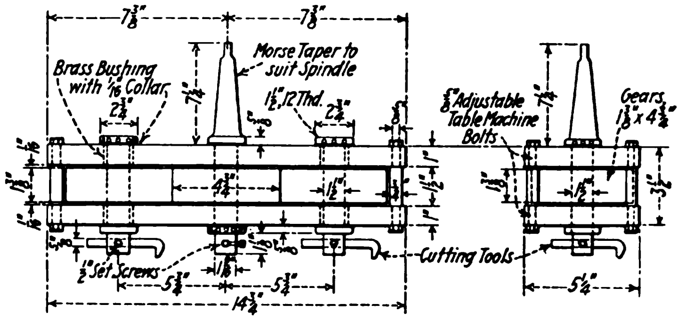
Merits of training schools for supervisory positions

I do not believe that a system of training can be inaugurated until the men are really familiar with the work. Most men get trained in the hard school of "experience." If the man you pick is working at a place where a slip foreman or a lead boilermaker is used, try and get him in one of these positions and with the right kind of supervision over him, he will, within a very short time, prove whether he is the man you want. If he does not prove successful, it is best to drop him out of the supervisory positions. There is no use dragging along with him as he will only prove a burden to himself and to the company.

It occasionally happens that we promote a night foreman to a day foreman, only to find out that he knows very little about the day work. Who is responsible for this? No one but the master mechanic and the day foreman; they have been neglecting their duty. I have all the sympathy in the world for a night foreman. He works in the dark and is generally kept in the dark. He generally has a very small force for the amount of work to be done; seldom ever sees any of the officers, quite often never sees the letters of instructions that are sent to the day foreman nor anything else pertaining to the running of the railroad. If anything goes wrong it is generally blamed on the night foreman. I seldom, if ever, go to an enginehouse but what I try to get to see the night foreman and talk things over with him. I also insist that certain instructions be given to the night foreman and have him acknowledge receipt of them to the day foreman. Most all circular letters that I send out have to be turned over to the night foreman to read, in fact, I try to have him made acquainted with all the facts that the day foreman gets.

Driving box oil grooving device

THE driving box oil grooving device, shown in the sketch, is designed to save time and labor as well as to obtain uniformity in all of the oil grooves on the shoe and wedge faces of the driving box. It is operated by a Morse taper shank designed to fit the drill press spindle. A driving box is placed on the table of the drill press, the taper shank of the grooving device is fitted into



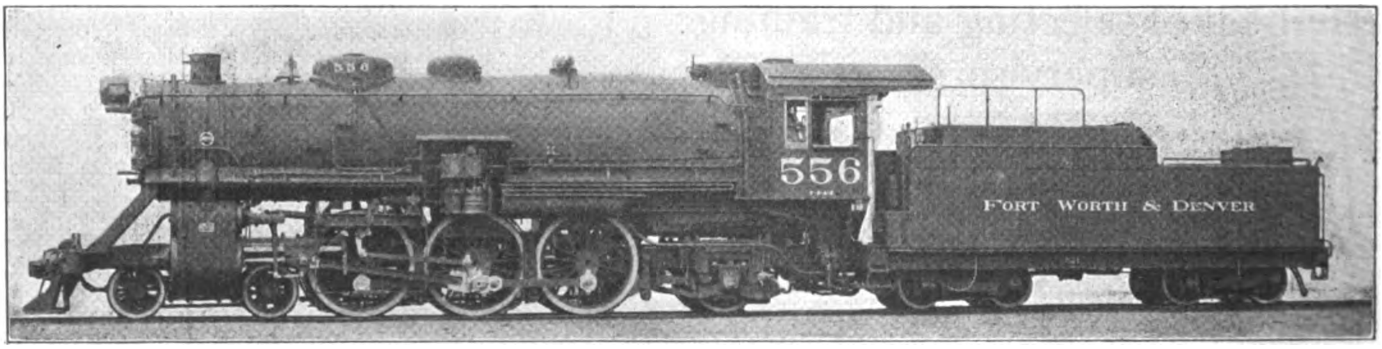
A device which will cut oil grooves on shoe and wedge faces to uniform depths

the drill press spindle, which is lowered to the shoe or wedge face of the box.

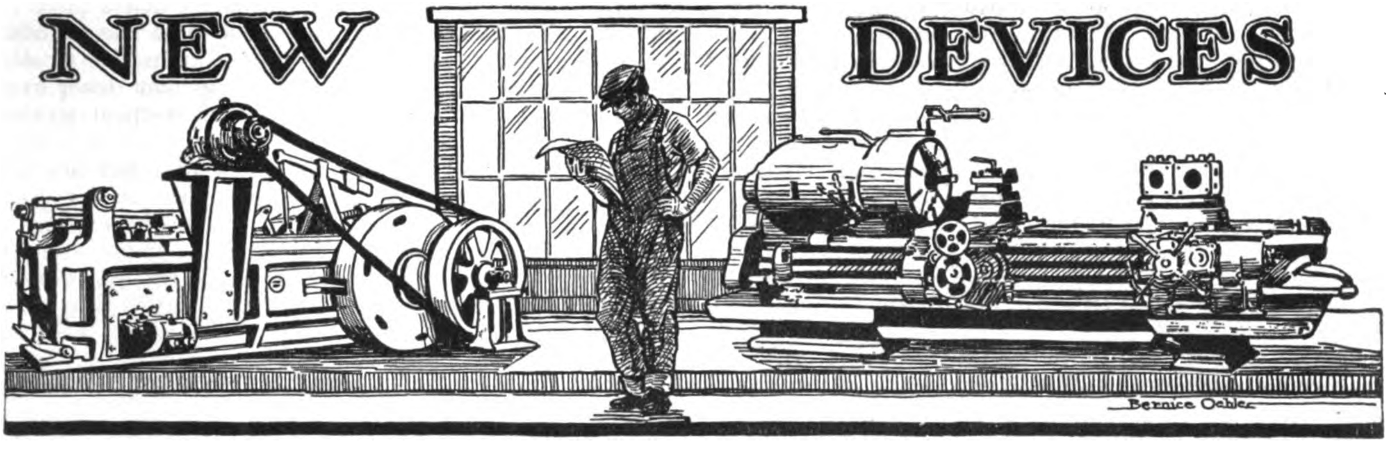
The cutting tools are turned by two gears which are held in a frame made of one-inch steel plate, 5¼ in. wide by 14¾ in. long. The center gear is rotated by the drill press spindle which meshes with the two gears that operate the cutting tools. By referring to the sketch, it will be noted that allowance has been made on the cutting tool gear shafts for the adjustment of the bottom plate.

The cutting tools are adjusted by means of the ⅝ in. adjustable machine bolts to suit the depth of the groove to be cut on the shoe and wedge face. The grooves are then cut to the required depth by the cutting tools which are turned by the three 1⅜ in. by 4¾ in. gears, shown in the sketch.

The principal advantage of this device is that all grooves have the same uniform depth which facilitates proper lubrication. This is practically impossible when the grooves are cut by hand.



Oil-burning Pacific type for the Fort Worth & Denver, built by the Baldwin Locomotive Works



Piston designed for gasoline rail car service

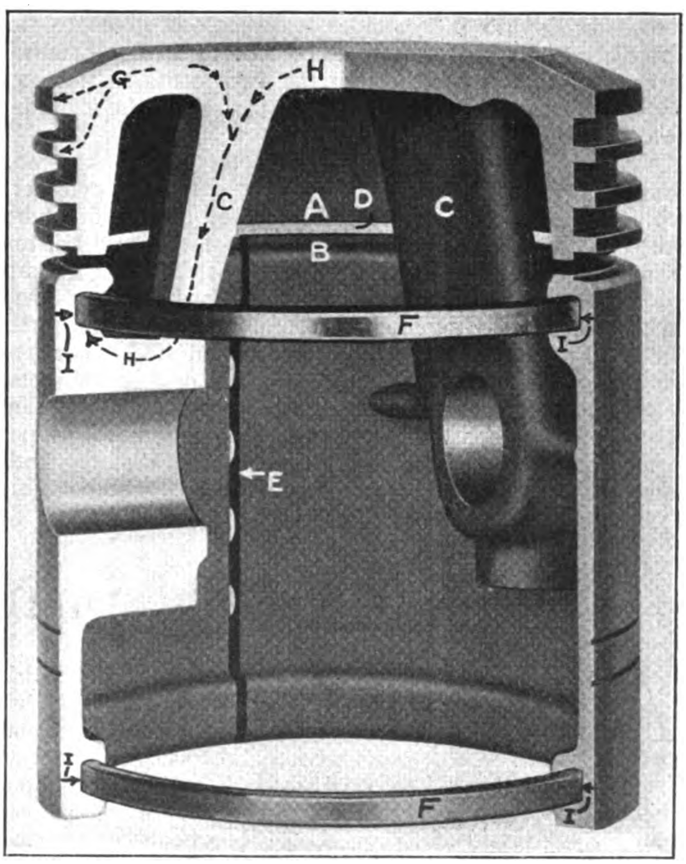
A NEW development which is assuming substantial importance in the railway field is the growing utilization of internal combustion engines as a source of motive power for major purposes. The gasoline hand car and track speeders have been a familiar sight for several years, and the gasoline passenger coach for rail service, while not so common as yet, is expanding its range of usefulness consistently.

This new field of service has brought the builders of automotive equipment face to face with a group of new problems, for the conditions encountered are radically different from those met by an automobile in road service. The automobile operates most of the time with throttle only slightly opened, being subject to full load only spasmodically and for short periods. The railway motor car, on the other hand, is driven on full throttle for many miles at a stretch without any chance to cool down or renew the oil film.

Thus a high temperature is built up and maintained without relief for long periods. But upon approaching a station or after topping the crest of a hill, the throttle is closed without declutching and the car coasts forward with little or no dimunition of speed. The engine continues to rotate and the pump circulates cold water over the cylinder walls at the same rate that it was flowing when working a full throttle, but combustion no longer occurs to produce heat. The cylinder walls are quickly chilled by this douche of cold water, and contract upon the piston, which cools much more slowly because not in direct contact with the water. In many cases this effect proved sufficiently drastic for the cylinders to bind the pistons fast, wrecking the motor and putting the unit completely out of commission.

In attacking this problem it became apparent that a practical method of controlling expansion and of governing the time of heat travel was essential to satisfactory performance. Extensive research in metallurgy eventually developed a method of producing an alloy of aluminum, copper and nickel in certain proportions, which assisted materially in solution of the difficulty. This alloy is particularly high in conductivity of heat, transmitting the calorific energy 3½ times as rapidly as cast iron does. Furthermore, this metal is very light and produces a piston weighing less than half as much as one of the same size made of iron, yet it actually wears longer than iron, is very hard, very tough and is not affected by the highest temperatures existing in a motor's combustion chamber.

But while these qualities made such an alloy very useful, the necessity for finding a way to regulate expansion was emphasized, for aluminum alloys expand twice as rapidly as cast iron when subjected to heat. Alloy pistons



Sectional illustration of a rail motor car piston

A. Piston head; B, Skirt; CC, Strut bars connecting the head to the piston pin bosses and transmitting the force of explosion direct to the connecting rod; D, Slot separating the ring belt from the skirt; E, Wave slit; FF, Steel bands controlling the skirt expansion; G, Path of heat travel from the outer portion of the piston head to the cylinder wall; H, Path of heat travel from the center of the head to the steel band controlling the skirt diameter; I, Direct path of the chill from the cylinder wall to the steel band.

for automobiles had been made with large clearances between pistons and cylinder walls when cold, so as to avoid the piston's becoming too large when heated. This had the disadvantage of giving poor compression in a cold motor,

with attendant oil pumping, drifting of gasoline to the crank-case to dilute the lubricant, and excessive wear.

But trouble more important than these is that caused by the fact that after the piston had expanded under heat to fit the hot cylinder, it did not cool as quickly as the cylinder walls cooled when drenched with cold water as the throttle was closed. The cylinder contracts more rapidly than the piston and seizure follows.

In order to overcome the problem of unequal expansion, a piston has been designed to take advantage of the conductivity of the improved alloy, known as Nickel-metal, which distributes heat rapidly from the centers of highest temperature to the cooler areas. In order to make the control of the heat more definite the head of the piston is completely separated from the skirt by a slot under the bottom ring. The head is attached to the piston pin boss by two substantial struts or bars of oval section. These transmit the pressure directly to the boss and the piston pin instead of putting the load on the skirt first and then on the outer end of the pin. The skirt carries practically no load at all, acting merely as a cross-head. The skirt, being entirely separated from the head, is comparatively cool and constitutes a capacious reservoir into which the heat of the piston head may be drained.

The struts supporting the head are cast in a location half way between the center of the piston head and its periphery. The heat of the outer portions of the head flows directly to the cylinder walls and is given to the circulating system for radiation. The heat of the central area is drawn down through the two struts to the cool skirt, where it is dissipated and passes to the cylinder walls.

A means of controlling the diameter of the skirt was sought in order to eliminate seizing when the cylinders chill and contract, also to gain precisely correct fit under all variations of temperature and do away with piston slap and oil pumping. In meeting this problem, advantage was taken of the fact that aluminum and iron will neither weld together nor combine chemically under heat. Two circular bands of low-carbon steel, about ¼ in. less in diameter than the piston, are cast in the metal —one near the top of the skirt, the other near the bottom. By means of splitting the cores, wave slots of proper width are provided on opposite sides of the skirt to allow space to compensate for expansion of the alloy. This slot is given a serpentine shape so that in case a piece of grit or other hard material should get into the cylinder and lodge in the slit it will be shifted from side to side and not cause damage by traveling up and down over the same path each time and causing a vertical scratch on the cylinder wall.

The steel bands are surrounded by alloy but are not fast to it, becoming in effect simply two tracks upon which the nickel-metal slides as the increasing expansion causes movement. The steel bands are of ample strength to prevent any enlargement occurring in the direction of the diameter, so the expansion is compelled to take place circumferentially, the metal sliding around on the steel bands partially to fill the wave slots on each side. Thus, the only expansion in diameter is that permitted by the expansion of the steel bands themselves, which is practically the same as that of the cylinders instead of that of the nickel-metal which is twice as great.

By having the head separated from the skirt, the desired control of heat travel and of rate of expansion and contraction is attained. To reach the steel band which governs the diameter of the skirt, the heat must travel from the center of the piston head down the struts to the pin boss, out the boss to the skirt, and up the skirt to the band. The result is that the heat of combustion, generated in the head of the cylinder, is transmitted to the cylinder walls more quickly than to the steel band of the skirt, so that there is no danger of the piston expanding more rapidly than the cylinder.

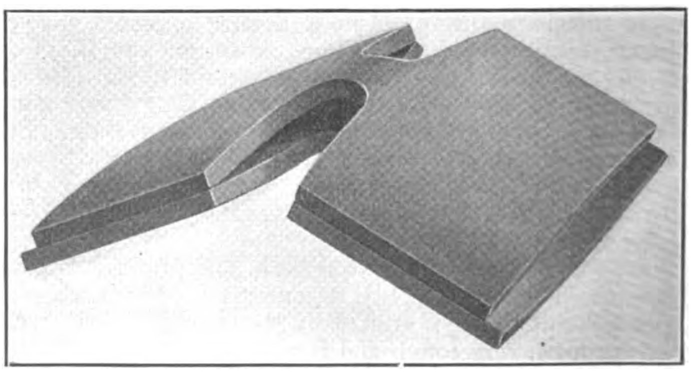
When the throttle is closed and production of heat ceases, and the flow of cold water cools the cylinder walls, the chill is imparted to the steel band immediately because only ⅛ in. of metal separates the band from the cylinder walls. Therefore, the diameter of the piston contracts quickly, remaining free of the cylinder walls as they cool.

It will be noted that this design causes heat to travel a circuitous route to reach the controlling steel band, while heat is conducted from it directly to the cylinder walls. Thus, is obtained the desired result of a piston which expands slowly under heat and contracts quickly under chill.

Pistons of this type are now being used with satisfactory results in a number of gasoline rail coaches. It has been placed on the market by the Butler Manufacturing Company, Indianapolis, Ind.

A friction spring bolster cushion

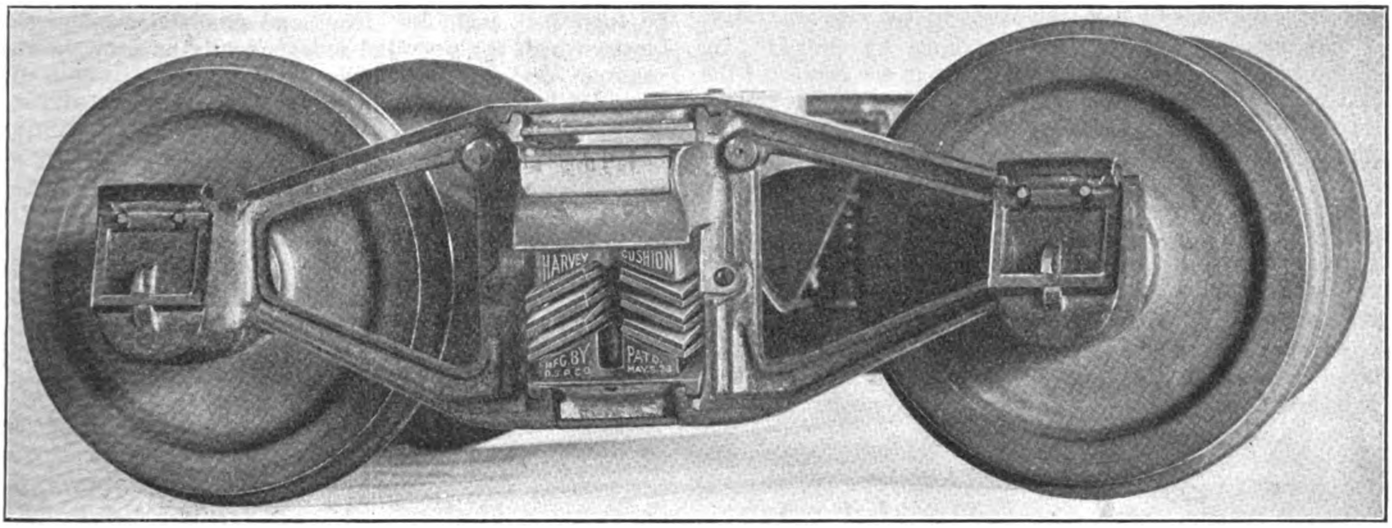
A FRICTION spring truck bolster cushion, which replaces truck springs of the ordinary type, has been developed by Frost Railway Supply Company, Detroit, Mich. This device known as the Harvey, friction bolster cushion consists of a top and a bottom malleable iron casting, called caps, and a series of concave and convex plates of spring steel. The plates and spring caps have angles sloping from the center outward, the top cap being concave and the bottom cap being convex. All plates and caps have the same angle with the horizontal. Each plate is cut out along the center axis into two sections which are joined by a narrow strip of the metal. It is this center portion or neck that is bent to give the two sections of each plate the correct angle to the horizontal. The whole assembly of plates and caps is held together by two long rivets. When the assembly is loaded, the lower heads of the rivets move down in pockets provided in the lower cushion cap. Only the ends of each pair of cushion plates are in contact on each side of the cushion. Each pair of plates is in contact with the next pair at the middle, and the top and bottom pairs are in similar contact with the top and the bottom casting.



A pair of the cushion plates

Thus it will be seen that as a load comes on the cushion each set or pair of plates bends closer together. Owing to the angle on the two sides of the cushion, the ends of each pair of plates must slide on each other. This slipping of the two plates that make up each pair is sufficient to produce several hundred foot pounds of absorption when the cushion is compressed and released. This absorption is said to be sufficient to stop the lateral rocking of the car. This rocking which is quite often caused by the time of vibration of the car body synchronizing with the passing of low joints, causes the bolster to move up and down on the side frame, when equipped with coil springs, as much as 1½ in. in the full capacity of the springs. In road tests of the Harvey cushion the maximum movement of the bolster up and down on the side frame is said to have been less than ⅜ in., which means that the rocking of the cars was very much reduced.

These springs are made to interchange with the ordinary nests of springs, so that they involve no change of standards. They are supplied in two classes, one for cars of 50 tons and under, and one for cars of over 50 tons. They can also be furnished for locomotive tenders.

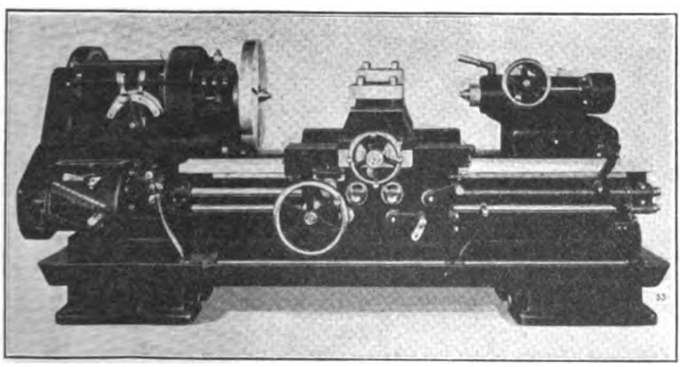


Application of the Harvey friction bolster cushion, showing how the complete assembly is held in place between the truck bolster and spring plank

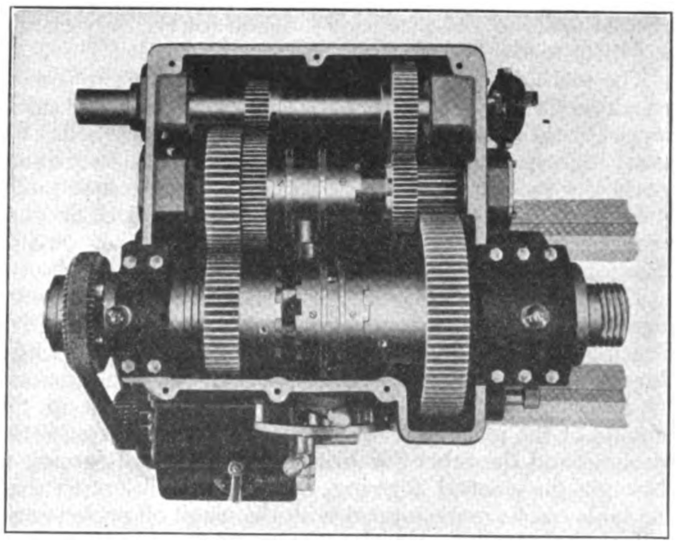
A Monarch heavy production lathe

The Monarch Machine Tool Company, Sidney, Ohio, has recently added to its line of tools a geared or cone head super-production lathe. The headstock gears are made from chrome nickel steel with face widths ranging from 2 in. to 3¼ in.

The auxiliary shafts in the headstock are mounted in a double row of heavy ball bearings. The spindle end thrust is also taken against a heavy ball thrust bearing. The sliding gears and clutches operate on large squared sections of the auxiliary shafts and spindle. Four or eight mechanical changes of spindle speeds are obtained by means of two levers on the front of the headstock which operates in a bath of oil. Either a constant or an adjustable speed motor drive can be furnished. The spindle bearings are exceptionally large—the front spindle bearing is 6½ in. in diameter by 10 in. long.



Monarch 26-in. by 10 ft. lathe



Four-speed geared headstock with auxiliary shafts mounted in heavy double row ball bearings

A 20 or 25-hp. constant speed or 3 to 1 variable speed motor can be mounted either on the floor at the rear of the headstock or on top of the headstock. The drive is through a silent chain to a large friction clutch sprocket

on the initial driving shaft. A constant speed motor of approximately 850 r.p.m. or less should be used. The friction driving clutch is capable of transmitting full power to the lathe and is operated by a lever at the right hand wing of the apron. An additional lever is attached to the apron enabling the operator to start, stop or reverse the lathe electrically, and in case of a variable speed motor, to secure any spindle speed electrically from the operator's position at the front of the lathe carriage.

The massive tailstock is held down by four 1¼-in. clamp bolts. There is also a rack cast in the center of the bed to help support the tailstock and keep it from sliding on the bed. It is provided with a hand-wheel and rack pinion for ease of moving. The thrust of the tailstock screw is taken against a heavy ball thrust bearing, between the shoulder of the screw and the end of the tailstock. The travel of the tailstock spindle is conveniently arranged for the operator by means of a pair of mitre and spur gears, bringing the hand-wheel to the front of the tailstock.

All apron gears and studs are of heat treated steel. The large cross and longitudinal feed frictions are operated by a large ball handle, which is a great convenience in operation as it prevents feed slippage under the heaviest cuts. All apron bearings are oiled from one central oil reservoir. All gears in the quick change gear box and feed mechanism are of heat treated steel. Operating shafts are made of a special grade of high carbon alloy steel.

The carriage has been designed for strength and durability. The cross bridge is 14 in. wide and takes a bearing on the front flat of the bed. Any type of tool rest can be furnished, including front and rear independent tool blocks which are operated independently or brought to a common center at the will of the operator. They are provided with automatic diameter stops.

The machine is built in 26-in. and 30-in. sizes. The following are the principal dimensions for the 30 in. size: Swing over the carriage, 20¼ in.; distance between centers, 3 ft. 4 in.; hole through the spindle, 2⅛ in., standard, 3 in. maximum; taper of the center, No. 6 Morse; range of threads per inch, quick change 1½ to 23; range of feeds per inch, quick change 7½ to 115; number of threads and feed changes, 32; tailstock spindle diameter, 5 in.; carriage length, 36½ in.; size of lathe tool, ⅞ in. by 1¾ in.; speed of geared head driving pulley, 150 r.p.m.

Betts double housing guide planer

THE Betts Works of the Consolidated Machine Tool Corporation, Rochester, N. Y., has recently completed several heavy duty planers of special design for one of the locomotive builders. These machines are used for planing locomotive guides and similar work, where, in order to get maximum production, it is desirable to cut in both directions. In order to accomplish this purpose two sets of housings are used, each carrying a crossrail on which are mounted two heads. As the two crossrails face each other two of the cutting tools are constantly at work. One set of housings is bolted to the bed in the usual manner. To accommodate the varying lengths of the work, the other set is adjustable along the bed by means of suitable slides, screws and nuts. A separate motor is used for moving this set of housings to the desired position and provision is made for securely clamping them to the bed.

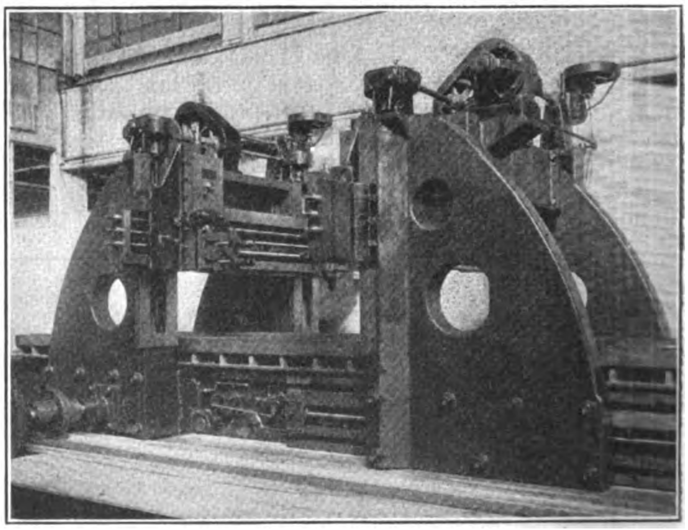
The main drive is by means of a 50 hp. reversing motor which has a speed range of 250 to 500 r.p.m., the entire range being used for cutting only; in other words, the usual high return speeds are dispensed with. The driving gears and rack are all steel, of wide face and coarse pitch, suitable for transmitting the high power required in connection with the heavy cuts that are usually taken on this class of work.

The table tracks, driving gears and driving gear bearings have forced lubrication in connection with a positive filtering system which insures an ample supply of clean filtered oil to these important bearings. Two pumps are used, driven by an independent motor mounted on the outside of the machine, one for forcing the oil through the machine and the other for bringing it back and forcing it through the central filtering unit. In addition to this, the table tracks are equipped with the usual oil pockets and rollers.

All four heads have electric feed and power rapid traverse. Both the feed and traverse are actuated by two electric feed motors, one for each set of uprights, and these same motors also furnish power for raising and lowering the crossrails.

The crossrail is clamped to the housings at both the inside and outside edges and is carried back between the housings a sufficient distance to provide ample rigidity when the tools are cutting close to the center of the table. The table is of the box type construction, and is gibbed to the bed for its full length to prevent any tendency to rise due to heavy cutting, which is an important feature on planing machines of this size.

The bed is of the box section type made with wide distance between the table tracks, and carries the dead shafts on which the driving gears are mounted.



Planer, designed with two sets of crossrails to cut in both directions

The capacity of the machine is 57 in. between the housings, 31 in. under the crossrail and 20 ft. between the table pockets. Convenient push-button stations are used for controlling the various motors. This arrangement permits easy operation of the planer and is such that the operator does not have to move any great distance in order to stop the machine.

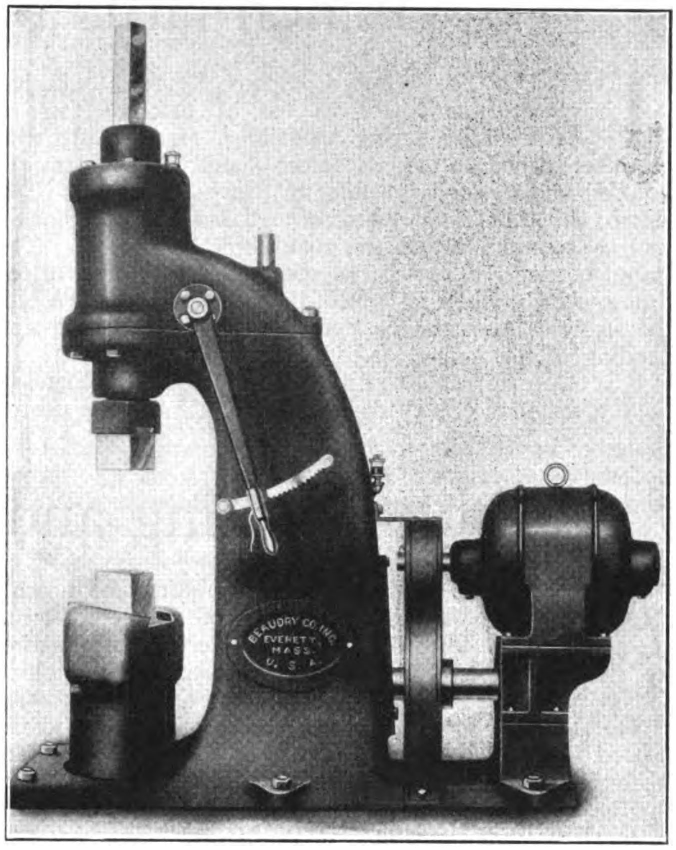
The Beaudry upright air hammer

THE Beaudry Company, Everett, Mass., has recently added to its line of blacksmith hammers an upright air-operated hammer. The compressor piston can either be driven by a belt-driven pulley or a motor. In operation the piston, when ascending, compresses the air above it and this flows into the ram cylinder, sending the ram upward with great speed. When near the top, air is trapped, forming a cushion, which causes the ram to rebound, and this, combined with the suction of the descending compressor piston, produces the hammer blow. The anvil which absorbs this blow is separate from the hammer frame and is supported on its own foundation, eliminating shocks to the hammer frame.

When equipped for belt drive, no countershaft is necessary as the hammer has a tight and loose pulley, the belt being shifted to the loose pulley only for long stops. The blow is regulated to suit the work by the foot treadle from a light, sensitive tap to the heaviest blow. The ram is held suspended when not working or when clamping the work for bending. Bars of any length may be worked either way of the dies.

The ram is designed so that the greater part of its weight is concentrated in a bar of large diameter, practically unbreakable, and is guided by passing through both the upper and lower cylinder heads. The head is entirely separate from the bar and can be readily removed when necessary to separate the ram from the cylinder, otherwise it is held securely to the ram by a wedge clamping ring. As the cushioning of the ram is done entirely by air, the use of springs or rubber cushions is avoided in this design.

The hammer is made in six sizes, with the weight of the rams ranging from 100 to 1,200 lb. The lift of the ram of the largest size is 26 in.; the number of blows, 110 per min.; the size of the motor, 40 hp., and the weight, 30,000 lb.



Beaudry upright, air operated, motor driven hammer

Portable electric circular hand saw

A PORTABLE, electric, circular hand saw adaptable for cutting car flooring, roofing and for general use about a car shop has recently been placed on the market by the Michel Electric Hand Saw Company, Chicago. It also can be used for cutting fibre, hard rubber, insulated cables, brass, light gage metal and many other materials.

Portable, electric, circular hand saw for the car shop

The body of the tool is made of No. 12 aluminum, which makes it light in weight and easy to handle. Every part of the tool is machined and is interchangeable. It has a cutting capacity of 2 in. in hardwood and will also cut many other materials requiring an equal power. It will groove or cut to any desired depth, up to 2½ in. Various attachments can be used for beveling or other purposes.

The motor used is of the universal type especially designed for this kind of a tool. Two types of motor are furnished, one for 110 volts a.c. or d.c. and the other for 220 volts a.c. or d.c. which are air cooled by forced ventilation. The saw is equipped with a trigger switch, the purpose of which is to insure safety, as the operator's finger must be held on the switch in order to keep the motor running. The motor, fan and shafts are dynamically balanced in order to eliminate vibration while in operation.

When first starting to make a cut, the front guide is rested flatly on the material to be cut before starting the motor. It is always advisable to keep the cutter away from the material until after the motor is started, then the saw blade is fed into the material always keeping the

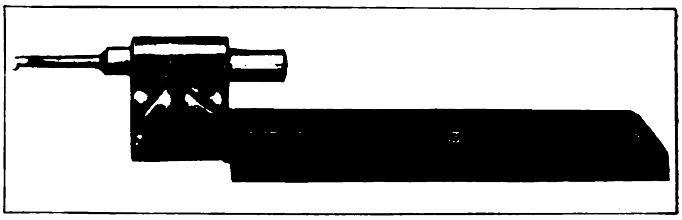
finger on the trigger. After the cut is completed, the trigger is released and the tool removed for a new cut.

The tool is known by the trade name of Skilsaw and is equipped with two 8-in. saws and 15 ft. of extension cord fitted with a plug which fits in any standard light socket.

Bench lathe boring toolholder

The J. F. Smith Tool Company, Dayton, Ohio, has recently added to its list of machine tools a bench lathe boring toolholder. It is made with an offset turned on the end of the shank which is straight knurled and has a large fillet to provide strength. The clamp, which fits over the offset and also holds the boring tool, is countersunk on the shank side to clear it. The clamp is made in two parts, with screws binding in the center, which, when tightened, draw the clamp down into the straight knurl on the shank, preventing slipping and bending of the toolholder.

It is easily adjusted to different heights and is made to hold ¼-in. bars of any desired length. With the use of this holder an operator is enabled to keep his bar on center and parallel with the hole being bored. It is 4 in. long with a 5/16-in. by ½-in. shank.



Toolholder suitable for boring small holes

Bolt-pointing and threading machine

A machine for automatically pointing and threading bolts that range in size from ¾ in. by 1 in., to ¾ in. by 6 in., has been placed on the market by the Economy Engineering Company, Willoughby, Ohio.

The operator fills the hopper located above and to the left of the machine, as illustrated in Fig. 1. A double-blade feeder, which is shown at the bottom of its stroke in Fig. 1 and at the top in Fig. 2, is automatically forced upward through the pile of bolts in the hopper and, on its way, gathers certain bolts the shanks of which fall between the blades. These are then suspended by their heads on the blade edges till, at the top of the stroke, the edges slop downward to coincide with a chute reaching from the hopper to the working section of the machine. The bolts then move down into this chute by gravity and the blade feeder returns to the bottom of its stroke and repeats to keep the chute supplied.

On the side of the chute near the lower end, there is an escapement that, by the operation two rods which alternately project into the path of the bolts, allows one bolt at a time to slide to the end of the chute where it is picked up by a transfer mechanism and carried to the chuck. This transfer mechanism is located, as illustrated in Fig. 2, at the lower end of the chute. It consists of a pair of cam-actuated spring fingers, which grip the shank of the bolt and deliver it to the chuck jaws, where the fingers are opened and returned for the next bolt that has been released through the escapement. The chuck jaws are operated by a cam-actuated toggle arrangement, illustrated in Fig. 2 at the left end of the machine. While a bolt is being placed for threading, the turret is locked against rotation.

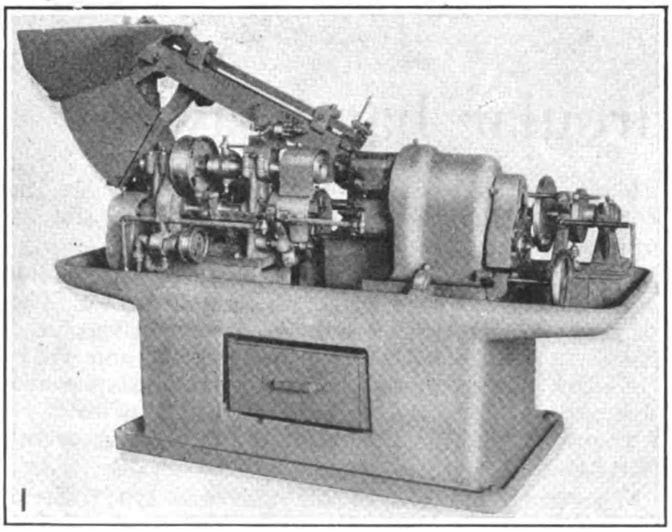


Fig. 1—Economy bolt-pointing and threading machine

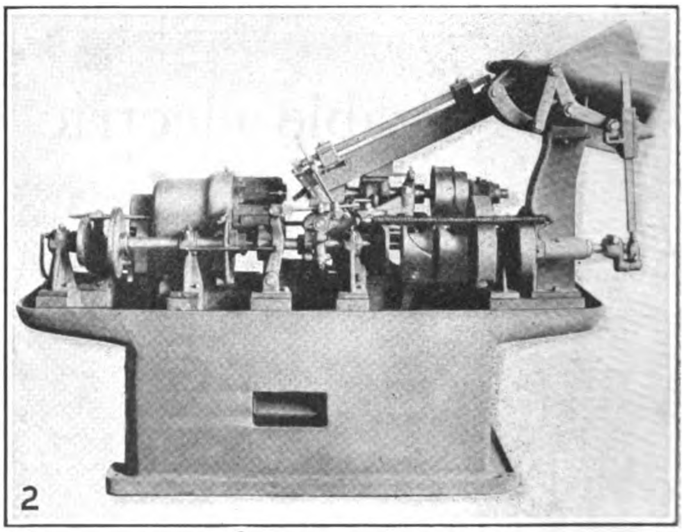


Fig. 2—Rear view of the machine

When the bolt is gripped in the jaws, the turret is released and immediately indexed 120 deg. to come into position with the pointing head which is located, as illustrated in Fig. 1, in the upper center next to the lower end of the chute. This movement also brings the blank that has just been pointed into place for threading in the dies which can be seen in Fig. 1 below the pointing head. The completely threaded bolt is carried around at the same time to the loading station and dropped out as the chuck

jaws are opened to take the next bolt from the feeder.

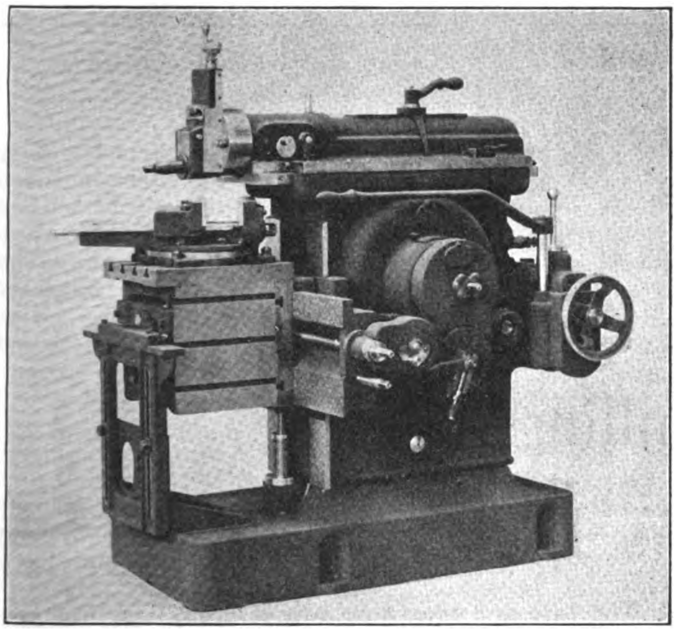
The pointing head and threading die are both fed forward by springs to reduce the possibility of jamming. Cams return them from the work. In the case of the threading die, there is a heavy spring for starting the thread that operates only for this part of the operation, when it comes against a stop and a light spring carries the head forward, overcoming only the drag of the moving parts. At the end of the stroke a cam opens the dies and returns the head to the starting point where another cam comes into action to close the dies, and then advances the head to position for the heavy spring to start the dies on the next bolt as it is indexed into position.

Change gears are provided to get the best ratio between speeds and feeds for a given size of work. The cams are arranged so they can be replaced to suit varying lengths and the turret head can be moved back after its clamps are loosened, to accommodate the longer sizes.

A capacity on ¾-in. by 1¼-in. U. S. standard bolts of 660 an hour is said to be attained.

Heavy duty back geared shaper

THE Stockbridge Machine Company, Worcester, Mass., has put on the market a 16-in. heavy duty, back geared shaper suitable for toolroom and die work. A gear box drive with a high ratio gearing provides ample power for heavy roughing cuts. The gear box is of the selective sliding type which works on the automobile shift principle.



Stockbridge 16 in., heavy duty back geared shaper

There are four changes of speed in the gear box and, with the back gears, eight changes in all are obtained. The gears are steel, heat treated and can be run in either oil or light grease.

The machine is driven and stopped by an automobile type of clutch which, when the machine is stopped, can be locked against any possibility of starting. This clutch is operated by a horizontal lever, which is extended to the front of the machine within easy reach of the operator. The ram can be moved back and forth, when positioning it, by this lever. A hand wheel is also provided on the side of the machine for hand setting the ram.

The base has been made of unusual depth for the purpose of strengthening it with deep ribs. A table support for the knee is carried on the base. This support gives a full width knee when in any position on the bar.

The cross feed will move the saddle in either direction by moving a handle to the right or the left without changing the position of the feed rod. The feed can be reversed without stopping the machine. It always operates on the return stroke of the ram and never feeds on the cut, thus eliminating the possible danger of breakage.

All the driving parts are heavily constructed. The vise is built to eliminate the overhang of the front jaw. It is also designed to keep the work as close to the top of the table as possible, the body of the base standing only 4½ in. from the top of the table. The jaws are 12 in. by 2½ in. and open to 12 in. The ram can be furnished with an automatic down feed.

Multiple spindle automatic screw machine

THE illustration shows a four spindle automatic screw machine of compact design, occupying a floor space of 116 in. by 42 in. and with a view of utilizing the full capacity of high speed tools, all of the machine members have been designed to insure permanency of alinement. This precaution is essential, due to the requirement of maintaining the dimensions of the product of automatic screw machines within close limits.

As this type of machine quickly accumulates many chips, a liberal amount of space has been provided between the tools and the chip pan. A further provision for the chips has been made by arranging the bed casting of the machine so that when the space directly under the tools has been filled with chips, any further accumulation is deflected by an inclined surface inside the bed at the center legs so that the chips can slide across into a compartment at the right hand side of these legs.

A door in the right leg of the machine gives access to a cabinet which accommodates the spindle speed change gears, which furnish seven changes of speed, ranging from 210 to 751 r.p.m.

A convenient feature of this machine is the design of a lever for opening and closing the chucks. As it is shown in the illustration, this lever is hanging straight down where it is out of the operator's way; but when it is required to put a new bar of stock into the chuck, or to release the chuck for any other reason, it is swung up on its pivotal support into a horizontal position. When so held, the rear end of the lever enters the space between the flanges on the chuck operating thimble, and then the hand lever is swung sidewise to open the chuck. When stocking up the machine, the spindle turret is indexed to bring successive spindles into the position where they can be engaged by this hand lever.

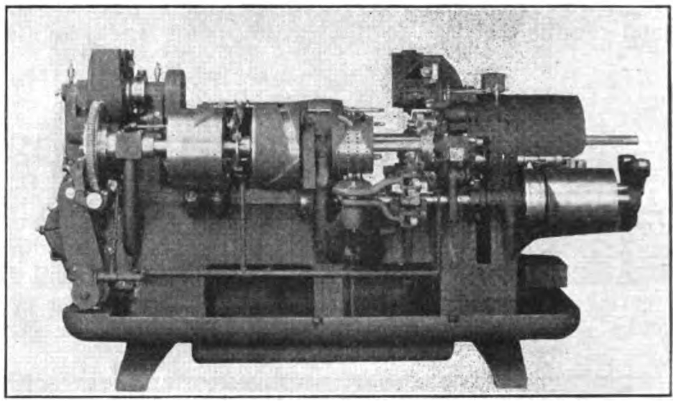
Of particular interest in the design of this machine is the arrangement of the high speed mechanism for effect-

ing indexing movement, and the low speed feed for controlling the working movements of the machine. There are two complete sets of gears for accomplishing these two classes of movement. For the high speed idle movements power is transmitted from a driving pulley, through bevel gears and a vertical shaft to a second pair of beveled gears and thence through spur gears to a worm meshing with a worm wheel on the feed cam shaft. These high speed gears are always running, but when the indexing movement has been accomplished, a clutch is automatically tripped by adjusting pins on the face of the worm wheel thus preventing further transmission through this drive.

The low speed drive for accomplishing the work feed movements is taken directly from the spindle driving gears. As a result, all feed movements, as expressed in inches per spindle revolution, remain constant regardless of how the spindle speed may be changed. From the spindle change gears, power is carried through suitable gearing to a pair of bevel gears which transmit to a vertical shaft, at the lower end of which there is a worm meshing with a worm wheel. From this worm wheel the drive is through a cone of spur gears and then through an intermediate gear controlled by a lever to a cross shaft which carries a ratchet.

Lubrication is an important feature. Oil is carried from the pump by individual tubes and delivered directly to the tool points where it is required. This eliminates the use of pipes above the turret. Attention is called to the fact that the oil pipes are of the telescopic type, so that they move back and forth as the tools advance to or recede from the work. As a result, the delivery of oil is always at the tool point. This is especially important in the case of the threading spindle, because by carrying the oil through the spindle and delivering it to the center of the die, the oil accomplishes the double purpose of lubricating the casers and washing out the chips.

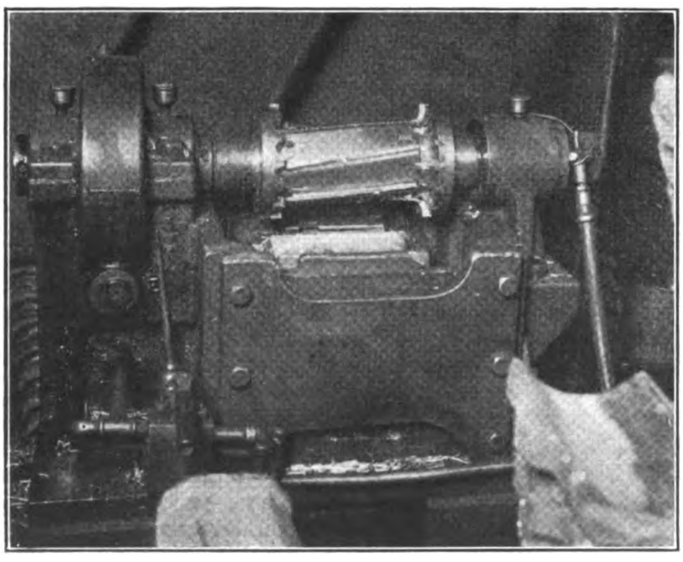
The machine has a capacity for handling 1½-in. round stock, 1¼-in. hexagonal stock, and 1 1/16-in. square stock. The maximum length of feed is 8 in. and the maximum milling length 6 in. The range from the turret face to the face of the chucks is from 7 11/16 in. to 13 11/16 in. The diameter of the turret holes is 1½ in. The machine may be equipped for either individual motor or belt drive. Where the individual motor is employed it may be either alternating or direct current, 10 hp. constant speed, running at 1,800 r.p.m. This machine is the product of the Cleveland Automatic Machine Company, Cleveland, Ohio.



Cleveland automatic screw machine well provided to take care of the chips

Journal brass milling machine

An essential job in connection with the maintenance of rolling equipment is the machining of new or second-hand journal brasses. These brasses must be machined accurately or serious trouble is liable to develop in the form of hot boxes caused by uneven bearing pressure. A machine has been patented by S. R. Parslow, 1276 Hague avenue, St. Paul, Minn., essentially for milling journal brasses to conform to the American Railway Association standard dimensions of length and thickness.



Machine for milling journal brasses which automatically clamps the brass in the chuck jaws and feeds it to the cutters

The base and the frame are of heavy cast iron construction. The carrier, which moves vertically to bring the brass against the milling cutter, is provided with four guides with proper adjustment for slack and is properly lubricated. The carrier is operated by an 8-in. air cylinder underneath the frame of the machine. An adjustable screw is provided in the piston rod of this cylinder which provides the correct amount of material to be machined from the brass.

The brasses are held by two pivoted chuck jaws operated by an air cylinder through powerful toggles. Each brass is located by standard lugs. The design of the machine is such that it will not start unless the brass is properly located in the chuck jaws. A safety feature which tends to reduce injury to the work and the machine.

By turning the operating valve, a friction clutch is engaged that starts the milling cutter to revolve and the chuck to close in and down on the brass, holding it securely and centrally with respect to the milling cutter. While this operation is taking place, the chuck carrying the brass is moved upward against the cutter until it reaches the proper thickness, then the operating valve is automatically reversed and the chuck drops back to its loading position.

Three-piece, inserted blade spiral cutters made of high speed steel are used. Some of these cutters have run as long as six months with a single grinding and at

the same time have turned out a desirable quality of work. Owing to the automatic nature of the clamping and operating mechanism, it is claimed that 120 brasses can be finished in an hour. The machine, which is belt-driven from a 3-hp. motor, will take brasses from 2 in. by 7 in. to 6 in. by 11 in.

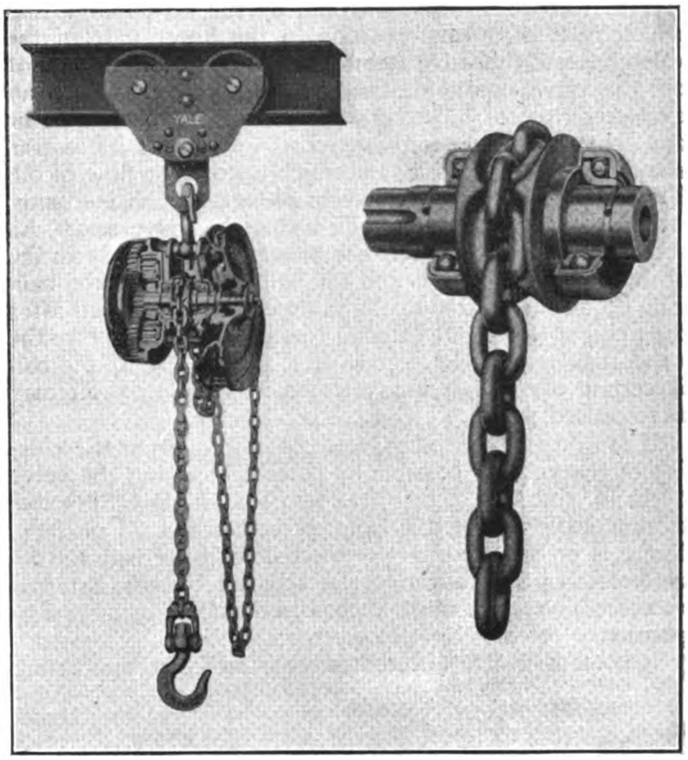
A ball-bearing spur geared chain block

An interesting development in hoisting equipment has just been placed on the market by the Yale & Towne Manufacturing Company, Stamford, Conn., in the form of a new ball bearing, spur-geared chain block. The design provides for two chrome alloy ball bearings to support the load sheave shaft, arranged so as to take the entire weight of the load and, in addition, to withstand the shock of all thrust and overload surges. The bearings are enclosed in small chambers so designed that by means of steel and felt washers dust and grit is prevented from entering.

The sectional view of the block in the accompanying illustration, shows the location of the massive steel load sheave carried on two ball bearings, each containing vanadium steel balls. The top hook, crosshead, suspension plates, load sheave, electric-welded load chain, detachable shackle, bottom crosshead and hook are all steel, so that the load hangs on a line of steel from hook to hook. It is claimed that the mechanical efficiency of this block has been increased over six per cent by the introduction of ball bearings at the points where they carry the full load.

In order to obviate the danger so common in hoisting, a great deal of attention has been given, not only to the size of the parts in the make-up of the chain block, but to the material entering into these parts. It is considered bad practice to put castings in any part of a chain block where they come in tension. It is considered better practice to use steel forgings, wherever parts come in tension in sustaining the load.

An additional feature is the continuous lubrication of the bearings, driving pinion, shaft and driving gears. This chain block is made in all capacities from ¼ to 20 tons.



Chain block provided throughout with ball bearings

Insulation for refrigerator cars

A somewhat unusual development has taken place in the field of refrigerator car insulation, with the advent of what is known as Dry Zero, manufactured by Johns-Manville, New York. This product is the result of intensive study and research work in the theory of heat transmission, in the effort to produce a light and efficient insulation particularly suited for refrigerator cars, where weight is a matter of prime importance.

In arriving at this new product, it was the aim of the manufacturer to find a material in which could be combined to the greatest possible extent, the following essential qualities which are desired by all refrigerator car operators.

The qualities are: the highest possible insulation value; light weight insulant; low moisture absorption; immunity from effects of impact, vibration and torsion; simple and inexpensive application; non-interference with and possible simplification of standard frame construction, and permanence of the insultant and its qualities.

It is claimed that these seven features have been included in the new insulating material. According to tests made by the Bureau of Standards and the Armour Institute of Chicago, Dry Zero insulation has a thermal conductivity of 5.66 B.t.u. per sq. ft. The 2-in. blanket which is principally used for refrigerator car insulation weighs less than 6 oz. a sq. ft. and has a density of 1.57 lb. a cu. ft. It is made up in any size in convenient blanket form, having longitudinal seams spaced 6 in. apart. It can also be used in bulk form—though in this form, it is not so easy to handle. It is claimed further that refrigerator cars insulated with Dry Zero insulation have shown a dead-weight saving ranging from 1,000 to 3,000 lb. on each car.

Dry Zero is a processed vegetable fibre which is hollow in structure, but the ends of each fibre are closed forming a myriad of natural combined air cells. It possesses the peculiar characteristic of being naturally moisture repellent, and also has considerable natural resilience, an inherent quality of the fibre, which counteracts any tendency to settle in a wall. The effects of impact, vibration and torsion are negligible.

On account of its light weight, it can be applied to standard car construction in one course and in one piece extending from the door frame on one side to the door frame on the other side, at the same time effectively insulating the corner posts as well as the other frame members.

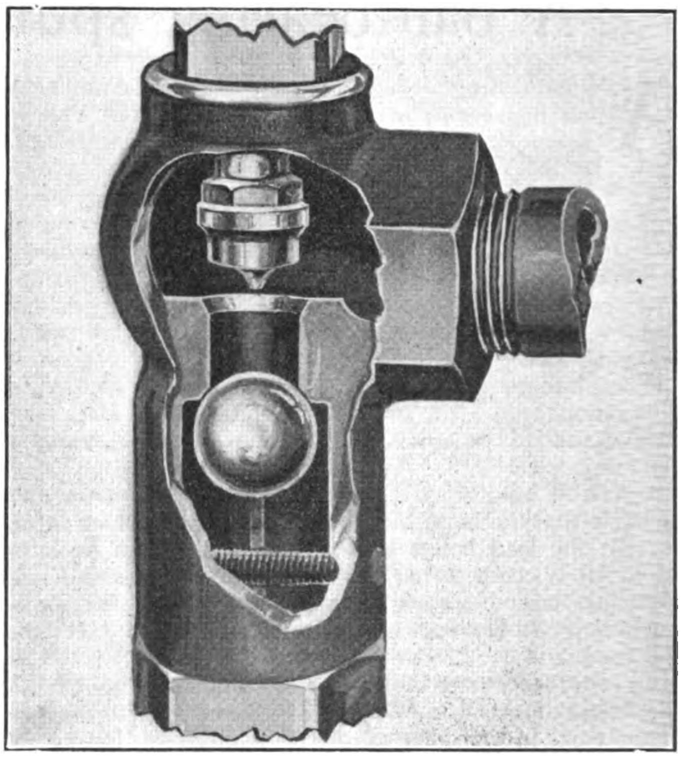
Automatic shut-off valve for oil lines

The breakage of an oil pipe usually leads to the loss of a considerable quantity of oil before the flow of oil through the break is stopped. The Johnston Manufacturing Company, Minneapolis, Minn., has developed an automatic shut-off valve, the action of which is analogous to that of a fuse in an electric circuit which shuts off the current in case of an excessive flow caused by a short circuit.

This feature is made possible by the action of a ball which rests in normal position in the lower part of the valve beneath the valve stem disk. With a normal flow of oil, the valve acts as a standard angle valve. When an excessive flow of oil occurs because of a broken pipe or any other cause, the ball is carried up against its seat as shown in the illustration, and quickly stops the flow of oil. The valve disk has an extension plunger which is a snug working fit in the oil passage below the valve seat. As soon as this plunger enters the passage, it forces down the oil between the plunger and the ball and releases the ball. The tip on the bottom of the plunger strikes the ball after the plunger has entered the oil passage and just before the valve disk reaches its seat so that the release of the ball is certain even after long service in very dirty oil may have caused wear.

It is said that no interference with the automatic closing of the valve is possible by partially opening the valve by hand, since the ball is free to rise and close the valve automatically before the plunger leaves the oil passage. There is no external part connected with the ball and its automatic operation cannot be affected by any external means. The valve must always be installed in a vertical position.

It is made in five different sizes from ½ in., increasing by ¼ in. increments to 1½ in., with a capacity in gallons per hour of 25, 100, 200, 350 and 800, respectively.

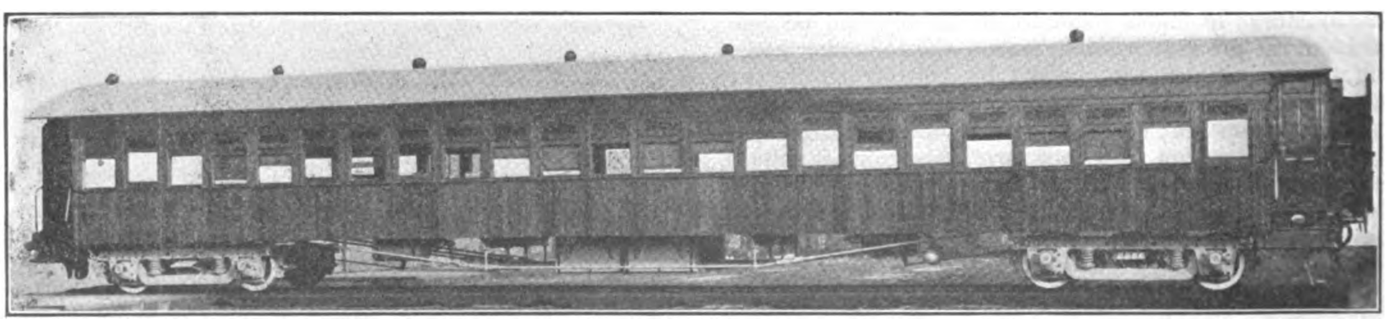


Valve closed by the automatic action of the ball to stop excessive flow of oil

Bearing metal adaptable to many purposes

Friction, wear and hot bearings have been the primary factors in retarding the speeding up of machinery. Two factors to be considered in reducing to a minimum these undersirable features are lubrication and bearings. Much attention has been given to the improvement of lubrication and little to the bearing material itself. It is contended that the ultimate source of bearing trouble lies in the material and not in the lubricant. J. E. Loudon & Co., Boston, Mass., conducted a series of experiments on bearing metals and finally developed a metal which is being marketed under the trade name of Mahanite.

An essential characteristic of a good bearing metal is its slow wearing quality. It is claimed for Mahanite that this characteristic has been obtained. Its lasting qualities make it an excellent bearing metal for high speed work. One of its properties is its cushioning effect which absorbs vibration. The metal is porous which provides it with ability to absorb oil, giving it a self-lubricating property. Mahanite may be obtained in the form of solid bars and solid or lined bushings. It may be used for machine and shafting bearing and car and locomotive journals. Grey iron is used for the sleeves of the lined bearings and bushings.



Passenger car built for the Central Argentine railway by the Gloucester Railway Carriage & Wagon Co., Ltd., London, Eng. Length over the buffers, 79 ft. 4 in.; height from rail, 13 ft. 3¾ in.; seating capaity, 138

General News

Edward Dahill, Jr., has been appointed chief engineer of the Freight Container Bureau of the American Railway Association, the new joint A. R. A. committee having decided that Colonel B. W. Dunn, chief inspector of the Bureau of Explosives, should devote his whole time to the explosives bureau. Colonel Dunn has had charge of the container bureau since its establishment. Headquarters, 30 Vesey street, New York City.

The Gulf, Mobile & Northern recently initiated a fuel saving contest for enginemen and firemen which has developed considerable enthusiasm, and promises to result in greatly increased interest in fuel conservation. It is expected that fuel saving records will be broken. The contest extends through the month of April and the winners will be sent at the expense of the company to the annual convention of the International Railway Fuel Association, at Chicago on May 26.

The Chicago Milwaukee & St. Paul during 1924 effected an excellent record in the conservation of fuel. In freight service the pounds of coal consumed per 1,000 gross ton-miles were reduced from 194.4 lb. in 1920 to 167.8 lb. in 1924. The consumption of coal per passenger car-mile in passenger service was reduced from 20.1 lb. in 1920 to 17.5 lb. in 1924. This saving in the use of coal amounted to 509,000 tons for the year, applied to the volume of business handled in 1924, and the saving in money, at the average price of coal in 1924, was $1,473,454.

The western roads have continued to sign agreements with the engineers and firemen on the basis of the Southern Pacific settlement, granting wage increases of approximately six per cent without important changes in working rules. A total of 46 western roads have now signed agreements. The latest roads include the Chicago, Milwaukee & St. Paul; the Atchison, Topeka & Santa Fe; the Duluth & Iron Range; the East St. Louis Junction; the Minneapolis & St. Louis; the Missouri-Kansas-Texas; the Northwestern Pacific; the Quincy, Omaha & Kansas City; the Texas & Pacific; the Union Railway of Memphis; the Oregon-Washington R. R. & Navigation Company; the Mississippi River & Bonne Terre; the Union Stock Yards of Omaha; the Chicago, Rock Island & Pacific; the Chicago, Rock Island & Gulf, and the Sioux City Terminal.

Locomotive Inspection Bureau's March report

The Bureau of Locomotive Inspection of the Interstate Commerce Commission in March inspected 6,676 locomotives, of which 3,007, or 45 per cent, were found defective, and 331 were ordered out of service, according to the commission's monthly report to the President on the condition of railroad equipment. The Bureau of Safety during the month inspected 110,475 freight cars, of which 3,696 were found defective, and 2,003 passenger cars, of which 26 were found defective. During March eleven cases, involving 14 violations of the safety appliance acts, were transmitted to various United States attorneys for prosecution.

Enola sets up a mile-stone

The shop of the Pennsylvania Railroad at Enola, Pa., opened on July 25, 1923, for the repair of the steel cars of the company, has lately completed work on the ten thousandth car, and the job was celebrated by having a photograph taken of J. W. Priest and his gang of 43 men, who did the work on this car. The total number of men employed in this shop at present is 833, of whom 419 own shares in the railroad company's stock. For the repair of steel cars there are three runways, on each of which there are three gangs of 43 men each; and two tricks are worked, thus employing 18 gangs in all. The daily output of this shop is from 37 to 40 cars. Repairing and rebuilding is done here for all parts of the Pennsylvania System.

Wage statistics for January

In January, 1925, the number of employees reported by Class I railroads was 1,728,333 a decrease of 8,366 or 0.5 per cent, as compared with the previous month, according to the Interstate Commerce Commission's monthly bulletin of wage statistics. The total compensation increased $3,011,216 or 1.3 per cent. Compared with the returns for January, 1924, the employment shows a decrease of 1.2 per cent and the total compensation an increase of 1.6 per cent. The most substantial change in straight time hourly earnings appears for the train and engine service employees, whose average straight time earnings per hour increased from 73.8 cents to 77.5 cents. For all employees reported on an hourly basis, the average straight time earnings per hour were 57.6 cents in January, 1924, and 58.8 cents in January, 1925.

Electric operation will be started on the Detroit & Ironton about June 1

First tests of the Detroit & Ironton locomotives will take place on a section of track just outside the River Rouge Ford plant at Detroit, Mich., about June 1. Foundations for trolley-support arches have been laid along three miles of this double-track line. Concrete parts for the trolley supports are being cast. Power for operating the road will be developed at 13,200 volts, 60-cycles, 3-phase alternating current. A frequency changer substation to be built near the power house will convert this energy to 22,000-volts, single-phase, 25-cycle alternating current power for use on

Freight cars installed and retired

Month—1924	Installed during month	Aggregate capacity tons	Retired during month	Aggregate capacity tons	Owned at end of month	Aggregate capacity tons	Building in R. R. shops
January	15,589	707,367	12,329	516,695	2,310,032	100,644,107	2,417
February	11,386	554,481	10,466	411,228	2,310,570	100,767,731	2,715
March	9,962	446,094	8,726	352,481	2,311,405	101,165,332	2,697
April	8,718	369,978	8,026	306,288	2,312,074	101,223,891	2,739
May	9,199	439,516	9,059	360,212	2,312,237	101,303,200	2,467
June	10,909	538,118	8,347	321,094	2,314,798	101,569,593	2,269
July	16,583	1,151,302	8,413	316,927	2,322,968	102,388,652	4,602
August	15,452	785,288	8,834	333,173	2,329,582	102,845,000	3,618
September	15,455	779,078	9,337	370,607	2,336,147	103,270,000	3,045
October	16,598	834,762	10,504	*418,816	2,342,149	103,688,000	*3,574
November	11,705	579,234	10,678	463,970	2,342,479	103,767,000	5,159
December	6,763	311,254	11,918	488,035	2,337,229	103,585,000	6,478
January, 1925	11,768	551,263	7,867	326,812	2,341,109	103,812,974	5,285
February	.....	......	.....	......	....	....	....
Total for 2 months	.....	......	.....	......	....	....	....

*Corrected figures.

Figures as to installations and retirements prepared by Car Service Division, A. R. A. Figures cover only those roads reporting to the Car Service Division. Figures of installations and retirements alike include equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

the trolley. The track and trolley are expected to be in condition for tests about June 1.

Three of the four sections of the first locomotive have been practically completed. The main wiring on the first section has been completed and the control wire is being installed. The main wiring has also been partially completed on the second and third sections. Flexible armored cable is being used for all main circuit connections. This is a wiring feature which has probably never before been used in an electric locomotive. All of the main direct current leads are covered with steel armor, while the alternating current leads are covered with brass armor. It is expected that the locomotive will be completed and ready for tests some time during April.

New equipment for South Africa

The Times (London) Trade Supplement summarizes the report of the general manager of the South African Railways for the fiscal year ended March 31, 1924, in part, as follows:

A number of locally constructed rail-motor vehicles of the converted road-omnibus type have been introduced, and with the object of gaining practical experience of types of rail motor-coaches in use in other countries orders were placed for a 68 hp. Service car to seat 38 passengers and for a Sentinel-Cammell steam-coach to seat 40. Experiments have also been made with a tractor coach equipped with a 120 hp. producer-gas engine and electric transmission. The fuel used for gas production is the char removed from steam locomotive smoke-boxes. The tractor has been in use between Kimberley and Winters Rush, hauling a composite passenger coach, and the results of the experiment have warranted the ordering of a 500 hp. producer-gas tractor.

A number of cars have been converted to form a train to be used for purposes of agricultural demonstration. In addition to a coach and dining car for the technical and supervisory staff, the train contains 12 cars equipped for the demonstration of various forms of agricultural activity.

Twelve dining cars of the new "twin" type were being built in South Africa. They are 60 ft. long and operate in pairs, each pair comprising a restaurant car with 46 seats and another containing pantry, kitchen, and sleeping accommodation for the staff.

Maintenance of doors, door fixtures, etc., on freight car equipment

Circular No. D. V.-393 has recently been issued by the Mechanical Division of the A. R. A. calling attention to the lack of maintenance of side doors, end doors, roof doors and hatch covers, door fixtures, tracks, guides, brackets, stops and sealing devices on house car equipment.

This lack of maintenance has resulted in a large number of claims for damage to lading by the elements, the pilfering of lading occasioned by easy access to cars, as well as the resultant loss of doors and liability by accidents. In many cases doors found off the track have been rehung simply by forcing them into place without making necessary repairs to the loose or otherwise defective parts which permitted the door to become displaced. Complete repairs of a permanent and substantial character should be made to cars, either owned or foreign, when found with defective door fixtures or sealing devices. Under no conditions should cars having defective doors, fixtures or sealing devices, be loaded.

Attention is further directed to the necessity of car owners adopting standards for maintenance that will insure doors and hatch covers on house car equipment being of such design as will prevent their readily becoming defective or losing off in ordinary service.

It is requested, therefore, that car owners inaugurate an intensive campaign at all repair points, freight houses and loading stations, to the end that a decided improvement may be effected, in order to avoid necessity for the establishment of a rule which would allow refusal of such defective cars when offered in interchange under load.

Court News

Engineers qualified experts as to power of air pumps.—The West Virginia Supreme Court of Appeals holds that locomotive engineers with from 10 to 15 years' experience in operating engines were qualified to testify as to whether or not one air pump was sufficient to control a heavy train.—Lambert v. Virginia Ry. Co. (W. Va.), 122 S. E. 457.

Movement of engine without headlight violation of boiler inspection act.—The Kentucky Court of Appeals holds that the movement of a locomotive without a headlight was a violation of the Boiler Inspection Act and the proximate cause of the death of a brakeman thrown from a cut of cars as the result of a collision.—Callihan's Admr. v. C. & O. (Ky.) 263 S. W. 339.

Return of defective car not violation of law.—A terminal company receiving cars for transfer between other roads received a car with a defective running board, marked it for return as in bad order, and retained it until a string of cars for the company sending it had accumulated, when it was returned. The Circuit Court of Appeals, Sixth Circuit, holds that such retention and return were not a violation of the Safety Appliance Act.—U. S. v. Louisville & J., 1 Fed. (2nd) 646.

Safety appliance act provision as to grab-irons does not apply to top of tender.—Judgment was obtained in an action in the Georgia state courts by a baggageman injured while assisting in coaling the engine of his train, by being thrown from the tender while climbing down the ladder, by a sudden jerk of the train. The case was brought to the United States Supreme Court on certiorari. Negligence in operating the train was charged, and also omission to equip the locomotive with the appliances required by law, the top of the ladder not reaching over the top of the flange at the rear of the tender, so that a person climbing down the ladder had no handhold except the sheet-iron flange. This was alleged to be a violation of Sec. 2 of the Safety Appliance Act, which provides that: "All cars requiring secure ladders and secure running boards shall be equipped with such ladders and running boards, and all cars having ladders shall also be equipped with secure handholds or grab-irons on their roofs at the tops of such ladders."

The trial court charged the jury that the grab-iron provision

Freight car repair situation

1924	Number freight cars on line	Cars awaiting repairs: Heavy	Light	Total	Per cent of cars awaiting repairs	Month	Cars repaired: Heavy	Light	Total
January 1	2,279,363	118,653	39,522	158,175	6.9	December	87,758	2,073,280	2,161,038
April 1	2,274,750	125,932	46,815	172,747	7.6	March	77,365	2,213,158	2,290,523
July 1	2,279,826	144,912	49,957	194,869	8.5	June	70,480	1,888,899	1,959,379
October 1	2,304,020	157,455	48,589	206,044	8.9	September	74,295	1,372,277	1,446,572
January 1, 1925	2,293,487	143,962	47,017	190,979	8.3	December	66,615	1,288,635	1,355,250
February 1	2,305,520	139,056	47,483	186,539	8.1	January, 1925	69,084	1,358,308	1,427,392
March 1	2,313,092	141,192	43,855	185,047	8.0	February	66,283	1,313,088	1,379,371

Data from Car Service Division Reports.

Locomotive repair situation

Date, 1924	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No. req. running repairs	Per cent	Total req. repairs	Per cent
February 1	64,377	53,586	4,116	5,919	9.2	4,872	7.6	10,791	16.8
April 1	64,363	52,805	4,648	6,128	9.5	5,430	8.4	11,558	17.9
July 1	64,416	53,382	7,117	6,035	9.4	4,999	7.7	11,034	17.1
October 1	64,538	53,209	5,424	6,175	9.6	5,154	8.0	11,329	17.6
January 1, 1925	64,384	53,118	4,849	5,927	9.2	5,339	8.3	11,266	17.5
February 1	64,308	52,994	4,220	6,143	9.6	5,171	8.0	11,314	17.6
March 1	64,255	52,851	4,988	**6,217**	**9.7**	**5,187**	**8.0**	11,404	17.7

Data from Car Service Division reports.

applied to a locomotive tender though it had no roof. Exception was taken.

The United States Supreme Court holds that the trial court erred in its charge on the effect of the statute, and the judgment of the Georgia Court of Appeals affirming judgment for the plaintiff was reversed and a new trial granted.

The Supreme Court said: "The word 'roofs' is the determining one. The Interstate Commerce Commission is empowered to designate the number, dimensions, location, and manner of application of the appliances provided for by Sec. 2. The commission's regulation as to ladders on tenders requires a suitable metal end or side ladder fastened with bolts or rivets. The omission to require a grab-iron is a practical construction by the commission. While the view of the commission is not conclusive with us, it is properly persuasive. We agree with it."—Davis v. Manry. Decided January 5, 1925. Opinion by Mr. Justice McKenna.

Meetings and Conventions

L. F. Loree to address Fuel Association convention

The International Railway Fuel Association has arranged an exceptional program for its seventeenth annual convention to be held at the Hotel Sherman, Chicago, May 26, 27, 28, 29. L. F. Loree, president of the Delaware & Hudson, J. D. Battle, traffic manager, National Coal Association, and President P. E. Bast, fuel engineer, Delaware & Hudson, are scheduled to make the opening addresses.

Wednesday, May 27, is known as "Operating Day" and the subjects to be discussed relate principally to the functions of the stores and operating departments. The program includes a paper by H. C. Pearce, director of purchases and stores, Chesapeake & Ohio; Mark Kuehn, chairman fuel committee, National Association of Purchasing Agents and G. M. Basford. Thursday, May 28, is to be known as "Mechanical Day" and the program includes papers by John Purcell, assistant to the vice-president, Atchison, Topeka & Santa Fe; and C. B. Smith, mechanical engineer, Boston & Maine. On the last day of the convention, J. W. Clark, chief fuel supervisor, Southern Pacific, is scheduled to read a paper on oil burning. The program is as follows:

TUESDAY, MAY 26

9:30 a.m.—(Daylight saving time). Opening addresses by J. D. Battle, traffic manager, National Coal Association. L. F. Loree, president, Delaware & Hudson. P. E. Bast (president), fuel engineer, Delaware & Hudson.
11:30 a.m.—Adjournment.
2:00 p.m.—Report of secretary-treasurer.
2:10 p.m.—Appointment of Auditing and other Special Committees.
2:20 p.m.—Unfinished business.
2:30 p.m.—New business.
2:40 p.m.—Report of Standing Committee on Fuel Stations.
3:30 p.m.—Report of Standing Committee on Fuel Accounting, Distribution and Statistics.
4:30 p.m.—Signals and the Saving of Fuel, B. J. Schwendt, superintendent of signals, New York Central Lines.
5:30 p.m.—Adjournment.

WEDNESDAY, MAY 27 (OPERATING DAY)

9:00 a.m.—How Can Fuel Purchases Affect Economy? H. C. Pearce, director of purchases and stores, Chesapeake & Ohio.
9:45 a.m.—Stocks, Consumption, and Production of Coal, Mark Kuehn, chairman, Fuel Committee, National Association of Purchasing Agents.
10:30 a.m.—Report of Standing Committee on Diesel Locomotives.
12:00 m. —Topical discussion. Effect on Fuel Consumption of Recent Developments in Operating Practice.
12:45 p.m.—Adjournment.
2:00 p.m.—Report of Standing Committee on Firing Practice (Oil section).
3:45 p.m.—Report of Standing Committee on Firing Practice (Coal section).
5:30 p.m.—Adjournment.

THURSDAY, MAY 28 (MECHANICAL DAY)

9:00 a.m.—How Can a Mechanical officer Affect Fuel Economy? John Purcell, assistant to vice-president, Atchison, Topeka & Santa Fe.
9:30 a.m.—Report of Standing Committee on Feedwater Heaters.
11:00 a.m.—Report of Standing Committee on Front Ends, Grates and Ash Pans.
12:00 m. —Topical discussion.
12:45 p.m.—Adjournment.
2:00 p.m.—Report of Standing Committee on Stationary Plants.
3:00 p.m.—Mechanical Means for Cleaning Locomotive Flues, C. B. Smith, mechanical engineer, Boston & Maine.
3:45 p.m.—Fundamental Fuel Factors, G. M. Basford.
4:45 p.m.—Report of Auditing and other special committees.
5:30 p.m.—Adjournment.

FRIDAY, MAY 29

9:00 a.m.—The Development of Oil Burning Practices on Locomotives, J. N. Clark, chief fuel supervisor, Southern Pacific Company.
10:00 a.m.—Report of Committee on Tanks.
10:15 a.m.—Report of Standing Committee on Constitution and By-Laws.
10:30 a.m.—Election of officers.
11:00 a.m.—Balloting for place of 1926 meeting.
11:30 a.m.—Convention adjournment.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next meeting May 26-29, inclusive, Alexandria Hotel, Los Angeles, Cal.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Business meeting to be held in Chicago June 16, 17 and 18. No exhibit of railway supplies and machinery will be held.
DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting September, 1925.
DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York. Next meeting May 19, 20 and 21, at St. Louis, Mo.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention August, 1925, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division. A. F. Steubing, Bradford Corp., 25 West Forty-third street, New York. Spring meeting May 18 to 21, inclusive, Milwaukee, Wis.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention week of September 14, 1925, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting, June 22-26, Chalfonte-Haddon Hall, Atlantic City, N. J..

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 20-24, Hotel Sherman, Chicago.

CANADIAN RAILWAY CLUB.—C. K. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings second Thursday each month, Hotel Statler, Buffalo, N. Y. Next regular meeting May 14. Paper on The New Locomotive will be read by W. H. Winterrowd, assistant to president, Lima Locomotive Works. Next interim meeting, June 11. Paper on Meeting Personnel will be presented by John G. Walber, vice-president in charge of personnel, New York Central. Young men's night.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November. Next meeting May 12. No paper will be read, but a musical entertainment will be given by Doc. Howard's Cuvier entertainers. Dinner party and smoker.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month at Hotel Cleveland, Public Square, Cleveland. Next meeting May 4. Paper on Train Resistance and Tonnage Rating will be read by F. E. Sellman, Master mechanic, Pennsylvania Lines.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention, Hotel Winton, Cleveland, Ohio, August 18, 19 and 20.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill. Next annual convention May 26-29, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Annual convention September 8-11, Hotel Sherman, Chicago.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Next convention May 19-25, Hotel Sherman, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting May 12. Annual banquet and entertainment.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Next meeting, Friday, May 15, 1925, at the Biltmore Hotel. Address by R. E. Woodruff, Erie Railroad, Buffalo, N. Y., on "Lubricating a railroad organization."

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Next meeting, Thursday, May 14, 1925.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in each month, except June, July and August. Next meeting May 8. Paper on Clay Products will be presented by J. C. Iselin, traffic manager, Blackman-Post. Moving picture showing development of clay industry.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September 15-18, 1925, Chicago.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 189 West Madison St., Chicago. Annual dinner May 23, Edgewater Beach Hotel, Chicago.

Supply Trade Notes

The Standard Stoker Company, Inc., has removed its New York City office from 5054 Grand Central Terminal to 350 Madison avenue.

The Midwest Forging Company, Chicago Heights, Ill., has moved its principal business office to 38 South Dearborn street, Chicago.

The Harnischfeger Corporation, Milwaukee, Wis., has appointed A. M. Lockett & Co., New Orleans, La., its agent in Louisiana and Mississippi.

Robert H. Blackall, 7 East Forty-second street, New York, has arranged for the rights to sell the Lawson pipe wrench in the United States.

A. H. Beale, president of the Lebanon Iron Company, Lebanon, Pa., has resigned to become president of the A. M. Byers Company, Pittsburgh, Pa.

The Whiting Corporation, Harvey, Ill., has opened a sales room at 997 Ellicott Square, Buffalo, N. Y., and has appointed W. R. Hans district manager.

The McGill Manufacturing Company, Valparaiso, Ind., has appointed the J. G. Pomeroy Company, San Francisco, Cal., its Pacific coast representative.

The Elvin Mechanical Stoker Company has removed its executive offices from 50 Church street to the third floor of 30 Church street, New York City.

E. H. Batchelder, Jr., Lytton building, Chicago, has been appointed western railroad representative of the varnish and enamel division of the Beaver Products Company.

The Kilby Car & Foundry Company, Anniston, Ala., has opened an office at 2038 Grand Central Terminal, New York, in charge of J. N. Brownrigg and Fred MacDonald.

The U. S. Light & Heat Corporation has removed its New York district office from the Grand Central Terminal to 161 West Sixty-fourth street, New York City.

Walter Bentley of the advertising department of the Railway Journal has been appointed sales manager of the Waugh Equipment Company, with headquarters in Chicago.

The Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio, has opened a new office at 203 East Fifteenth street, New York, in charge of L. Wechsler, sales representative.

Alfred W. Lockwood has joined the sales organization of the Bridgeport Brass Company, Bridgeport, Conn., as a special representative, operating out of its New York office.

William H. Keller, Inc., has removed its office from 50 Church street, New York, to 50 Dey street, where a complete line of pneumatic tools and repair parts will be carried.

W. W. Glosser has been appointed general sales manager of the Verona Tool Works, Pittsburgh, Pa., and Frank B. Nimmo has been appointed assistant general sales manager.

The quick change speed sensitive drilling machine business of the Sipp Machine Company, Paterson, N. J., has recently been purchased by the Foote-Burt Company, Cleveland, Ohio.

The Gould Coupler Company and the Gould Storage Battery Company, Inc., have removed their offices from 30 East Forty-second street to 250 Park avenue, New York City.

J. C. Davis, of the sales department of the Ohio Injector Company, with headquarters at Wadsworth, Ohio, has been promoted to assistant sales manager, with the same headquarters.

Fred C. Schreiber, representative of the Stocker-Rumely-Wachs Company, has resigned to become sales representative of Manning, Maxwell & Moore, Inc., with headquarters in Chicago.

M. B. MacNeille, chief engineer of the hydraulic department of Fairbanks, Morse & Co., with headquarters in Three Rivers, Mich., has been promoted to manager of the pump division.

The Globe Steel Tube Company, Milwaukee, Wis., has opened a district sales office at 444 Frisco building, St. Louis, Mo., and has appointed E. C. Carroll manager of sales for that district.

The Ohio Locomotive Crane Company, Bucyrus, Ohio, has placed Arnold Walters, district sales manager, in charge of a newly opened district office at 647 Book building, Detroit, Mich.

The Whiting Corporation, Harvey, Ill., has removed its Chicago district sales office from 945 Monadnock block to 1502 Railway Exchange. R. S. Hammond is district sales manager.

The Kansas City Bolt & Nut Company will construct a one-story plant 90 ft. by 240 ft. in Kansas City, Mo., at an estimated cost of $23,000. A branch office has been opened at Tulsa, Okla.

The Elwell-Parker Electric Company, Cleveland, Ohio, has appointed J. P. Lyons, 612 Citizens and Southern Bank building, Atlanta, Ga., its district engineer for the territory contiguous to Atlanta.

At the recent annual meeting of the stockholders of the Yale & Towne Manufacturing Company, Stamford, Conn., the eight directors in office were unanimously continued as such, Vice-President Schuyler Merritt being elected chairman of the board and Gabriel S. Brown, a director to fill the vacancy caused by the death of Henry R. Towne. Addison Boren, assistant to the president and controller, was elected treasurer, succeeding J. H. Towne, who still retains the office of secretary. Mr. Towne's relinquishment of the treasurership was due to increasing encroachment on his time by other matters. Mr. Merritt, the newly elected chairman of the board, entered the Yale service in 1877 as an office assistant. In 1878 he was elected a director and at the same time secretary of the company. He served as treasurer from 1898 to 1902 and since then as a director. Educated for the law, he has always had charge of the company's legal affairs and also of its patent interests. During recent years he has given special attention to the business of the bank lock department. He is also chairman of the board of directors of the First-Stamford National Bank, and has represented the Fourth Congressional District of Connecticut in Congress since 1917. Mr. Boren, who has been elected treasurer, came to the service about seven years ago as manager of the Works Accounting Bureau. After completing his education he became associated with the Best Manufacturing Company of Pittsburgh, with whom he remained for 15 years. He then engaged in the public accountant business until his removal to Stamford to take up tasks with Yale & Towne. Mr. Boren served successively as chief accountant, controller, assistant to the president and finally treasurer. He is a director of the National Association of Cost Accountants and a certified public accountant of Connecticut.


Schuyler Merritt

W. H. East, assistant electrical engineer of the Chicago, Burlington & Quincy, with headquarters at Chicago, has resigned to become railway sales engineer of the Central Electric Company, Chicago.

Benjamin Nields, Jr., sales agent for the National Malleable & Steel Castings Company, Cleveland, Ohio, has removed his office from 30 Church street to 17 East Forty-second street, New York City.

The Harnischfeger Corporation, Milwaukee, Wis., has removed its Pittsburgh, Pa., sales office from the Fidelity building to 612 Farmers Bank Building, Fifth avenue and Wood street. A. J. Dreyer is district manager and M. B. Bradley is sales engineer at this office.

The Minwax Company, Inc., has removed its office from 18 East Forty-first street to 270 Madison avenue, New York City.

Its Chicago district office has been removed to 10 East Huron street, Chicago.

E. S. Jackman & Co., agents of the Firth-Sterling Steel Company, have removed from 333 Frankfort avenue, Cleveland, Ohio, to their new warehouse and office at 1424 East Twenty-fifth street, N. E. Cleveland.

Arthur E. Bendelari, who has been in charge of operations in Missouri and Oklahoma for the Eagle-Picher Lead Company, has been appointed vice-president and treasurer to succeed Thomas R. Brown, Jr., retired.

J. B. Murphy, district sales manager for the Minneapolis territory of J. D. Wallace & Co., manufacturers of woodworking machinery, has been promoted to assistant sales manager, with headquarters in Chicago.

The Truscon Steel Company, Youngstown, Ohio, will erect two warehouses in Buffalo, N. Y., on a piece of land 400 ft. by 150 ft., at Bailey avenue and William street. One will be erected at once and the other in the fall.

C. A. Ilgenfritz, assistant purchasing agent of the Youngstown Sheet & Tube Company, has been appointed purchasing agent of the United Alloy Steel Corporation, Canton, Ohio, to succeed George W. Starr, resigned.

Joseph M. Welles has been appointed resident representative of the Standard Coupler Company, New York. Mr. Welles will have his headquarters in the Peoples Gas building, Chicago. He succeeds W. Eckels, resigned.

W. Sharon Humes, sales representative of the Magnus Company, Inc., with headquarters in Chicago, has resigned to become sales representative of the Central Brake Shoe & Foundry Company, with headquarters in Chicago.

H. G. Von Nostrand of the sales department of the Illinois Steel Company, Chicago, and formerly manager of tie-plate sales of the Railroad Supply Company, Chicago, died on March 19 following an illness of six weeks.

The Master Tool Company, Cleveland, Ohio, reclaimers of pneumatic tools, has appointed M. W. Scott, eastern representative, with headquarters in Pittsburgh, Pa., and A. B. Stewart & Co., Chicago, western representative.

The Davis Equipment Company and M. E. Davis, dealers in railroad and construction equipment have removed their offices from 50 Church street to 8 West Fortieth street, New York City.

Matt J. Herold, formerly in charge of sales in the East Central division of the Wood-Imes Manufacturing Company, has resigned to become general sales manager of the United States Electrical Tool Company, Cincinnati, Ohio.

S. G. Down, vice-president of the Westinghouse Air Brake Company, Wilmerding, Pa., has been elected also a member of the board of directors, filling a vacancy on the board created by the death of Morris Rosenwald.

G. W. Brogan, Inc., Towson, Md., is now acting as merchandising counsel and handling the advertising of the Bonney Forge & Tool Works, Allentown, Pa., manufacturers of drop forged wrenches and of the chrome vanadium wrench.

Paul T. Farrell of the purchasing department of the Youngstown Sheet & Tube Company, Youngstown, Ohio, has been promoted to assistant purchasing agent to succeed C. A. Ilgenfritz, resigned to accept a position with another company.

The Mid-West Forging Company, Chicago, is enlarging its works at Chicago Heights, Ill., by the addition of a steel building 50 by 120 ft. for manufacturing purposes, a steel building 40 by 70 ft. for steel storage and a warehouse 40 by 120 ft.

A building used for the storage of pattern and flash lumber at the Berwick, Pa., plant of the American Car & Foundry Company was totally destroyed by fire on February 27, entailing a loss of from $400,000 to $500,000. The loss will not delay production.

William C. Wolfe has been appointed district sales manager, welded and weldless division of the American Chain Company, Inc., Bridgeport, Conn. Mr. Wolfe's headquarters are at 208 South La Salle street, Chicago. He succeeds George C. Isbester, resigned.

The Houston Car Wheel & Machine Company, Houston, Tex., is preparing plans for extensions, including a one-story building 75 ft. by 200 ft., the installation of an electric furnace, electric traveling cranes, heavy duty machine tools and auxiliary equipment.

The Railway Car Forging Company, Chicago, has been incorporated to manufacture iron and steel forgings, pressed steel parts and other metal products for car equipment. The company has taken over the Chicago Heights, Ill., plant of the Illinois Car & Manufacturing Company.

The Firth-Sterling Steel Company, E. S. Jackman & Co., agents, has moved its Los Angeles, Cal., office from 336 East Third street to larger quarters at 2154 Santa Fe avenue, Los Angeles. William Ely Nelson, who has been with the company almost 25 years, is Pacific coast representative.

The G. A. Gray Company is constructing a new shop and office building at Evanston (Cincinnati), Ohio. The shop is to be a steel frame building, 420 ft. by 210 ft., with walls of steel sash and glass. The office will be a two-story brick building, located at the eastern end of the shop.

Howard Longstreth, secretary of the Lebanon Iron Company, Lebanon, Pa., has been elected president to succeed A. H. Beale, who has resigned to accept service with another company. H. W. Pratt has been appointed secretary-treasurer and J. J. McDermott has been appointed assistant treasurer.

The Morton Manufacturing Company, Chicago, has appointed the Crowe-Matthews Company, 212 Douglas building, Seattle, Wash., and 1177 Dock street, Tacoma, Wash., its exclusive and direct representative covering the sale of Acme line of railway appliances in the northwestern section of the United States.

The Walworth Manufacturing Company, Boston, Mass., recently formed an engineering products division to co-operate with the engineering production and sales departments of the company. John M. Olmsted has been appointed general manager of the division, with headquarters in Chicago and Fred W. Duemler, assistant manager at New York.

Lyle Marshall, former manager of the service department of the Industrial Works, Bay City, Mich., and later connected with the Chicago office, has been promoted to district sales manager in the newly opened office at 619 Dixie Terminal building, Cincinnati, Ohio. James E. Shearer, assistant sales manager, Bay City, Mich., has been transferred to New York.

Andrew C. Duncan, 2835 Washington Boulevard, St. Louis, Mo., has been appointed district engineer for the Elwell-Parker Electric Company, Cleveland, Ohio, for the territory contiguous to St. Louis. George C. Hays has been appointed district engineer of the territory contiguous to Indianapolis, Ind. Mr. Hays' headquarters are 225 Indiana Terminal Warehouse building, Indianapolis.

The Bird-Archer Company, New York, is now conducting its Canadian business entirely from a general office at 300 McGill building, Montreal, Que. Previously the Canadian business has been conducted from the head offices at New York; the Canadian factory and laboratory will be located at Cobourg, Ont. Hugh C. Harragin is in charge of the administration of the Canadian business with head offices at Montreal.

The Electric Storage Battery Company, Philadelphia, Pa., has bought land as a site for a factory branch to be built in Boston, Mass., on Ashford street, near Babcock. The new building will cover about 35,000 sq. ft., and will consist of a two-story office fronting on Ashford street, with a one-story manufacturing establishment in the rear. It will be of modern daylight construction and the equipment will be modern in every respect.

Harry B. Gilmore, for the past 17 years manager of the distributing organization of the Western Electric Company, at Boston, Mass., has been elected secretary of the company. A few months ago he was made assistant secretary and was transferred to New York. He succeeds as secretary George C. Pratt who in the future will devote his entire time to his duties as general attorney. Donald S. Pratt was elected an assistant secretary to Mr. Gilmore.

C. M. Robertson, vice-president in charge of Chicago sales of the Consolidated Machine Tool Company, has resigned to become sales engineer of the Orton & Steinbrenner Company. From 1901

to 1908 he was superintendent of the Colburn Machine Tool Company, Cleveland, and from the latter date until 1918 he was manager of the Chicago territory of the Essley Machine Tool Company. From 1918 until his recent promotion he was vice-president in charge of the Chicago sales of the Consolidated Machine Tool Company.

The Linde Air Products Company, New York, manufacturer and distributor of oxygen for welding and cutting, has opened the following new district sales offices: In the First National Soo Line building, Minneapolis, Minn., C. E. Donegan, district sales manager; Lincoln Life building, Birmingham, Ala., W. A. K. Popp, district sales manager, and in the Exchange National Bank building, Tulsa, Okla., G. D. Grubb, district sales manager. J. W. Foster, senior salesman in the Pittsburgh Linde district, has been appointed district sales manager at Baltimore, Md.

The Gold Car Heating & Lighting Company, New York, will be temporarily represented in the Chicago territory by F. O. Bailey, manager of sales, and A. D. Stuyer with address the same as heretofore. W. G. Willcoxson is no longer connected with the company. W. H. Ivers, who has again become associated with the company, will be located at St. Louis, Mo., and will represent the territory formerly represented by W. J. Roehl. Tom Moore has been appointed representative in charge of the southern territory, with headquarters in the Royster building, Norfolk, Va. Mr. Moore was formerly purchasing agent of the Virginian Railway.

Farrand P. Hall has been appointed district sales manager of the Carborundum Company in charge of the sales organization and branch warehouse at Cleveland, Ohio, succeeding John MacArthur, who has been assigned to special sales service work at Niagara Falls, N. Y. Mr. Hall joined the Carborundum sales force in 1914 as a salesman, covering the territory in and about Montreal and the Maritime provinces. From 1916 to 1922 he was engaged in the retail hardware business, returning to the Carborundum Company in 1922. Mr. MacArthur has been a member of the sales force since 1909. He was appointed district sales manager at Cleveland in January, 1919.

O'Neill Ryan, Jr., has been appointed advertising manager of the Celotex Company, Chicago, to succeed M. F. Harris, resigned. W. L. Bryson, formerly district manager of the Beaver Products Company, Kansas City, Mo., has been appointed manager of the St. Louis division, with headquarters at St. Louis, Mo. The Celotex Company has granted a license for the manufacture of its product in Australia to a new company which is now being organized by H. C. Armstrong, Sydney, Australia, in conjunction with Crawford Vaughan, ex-premier of South Australia. This company will erect a mill at a cost of approximately $650,000 which will have a yearly capacity of 30,000,000 ft.

R. P. Townsend has been appointed eastern assistant manager of the railroad department of Johns-Manville, Inc., with headquarters at New York. Mr. Townsend entered the service of the New York Central in November, 1906, after having graduated from Walworth Institute. He resigned in July, 1917, to become purchasing agent and later assistant to vice-president of the Liberty Steel Products Company, which later changed its name to the American Railway Appliances Company. Mr. Townsend resigned from that company in March, 1924, to enter the railroad department of the Murphy Varnish Company, which position he held until his new connection with Johns-Manville, Inc.

The Oneida Manufacturing Company, Green Bay, Wis., has been acquired by the Railway Motors Corporation, Railway Exchange building, Chicago, which has been incorporated under the laws of Delaware with a capital of $1,000,000. Officers of the new company will be, president, L. W. Melcher, president and general manager of the Oneida Manufacturing Company; R. E. Frame, treasurer of the Central Brake Shoe & Foundry Company, Chicago; A. C. Deverall, formerly general superintendent of motive power of the great Northern; A. A. Aggerbeck, Chicago; J. H. Taylor, president of the McCartney National Bank, Green Bay, Wis. The Green Bay plant will be used to manufacture power units. Other plants will be established in various districts.

Ralph C. Davison, engineer of the American Abrasive Metals Company, New York, died of pneumonia on April 15 at his home in Plainfield, N. J., at the age of 50. Mr. Davison was educated at Stevens Institute. He became associated with the American Abrasive Metals Company in January, 1918, and previously had served for about ten years with the American Mason Safety Tread Company, New York, in a selling and engineering capacity and as a director. He had also been connected with the Concrete Association of America, and at one time was an associate editor of the Railroad Gazette. Mr. Davison was a member of the American Society of Mechanical Engineers, the American Society of Safety Engineers and the New York Railroad Club.

The extensive patent litigation which has been going on since 1911 between The Safety Car Heating & Lighting Company and the U. S. Light & Heat Corporation, and its predecessor, The United States Light & Heating Company, recently resulted in a judgment against the U. S. Light & Heat Corporation for over $500,000. The parties have agreed to settle this judgment by the sale to The Safety Car Heating & Lighting Company by the U. S. Light & Heat Corporation of all of its patents, machinery, equipment and inventory used in, or connected with car lighting. This sale does not include USL arc welders or the USL batteries. U. S. Light & Heat Corporation will therefore continue to manufacture and sell arc welders and a complete line of batteries, including train lighting batteries. The Safety Car Heating & Lighting Company will be in position to furnish USL type car lighting devices, repairs and replacements.

Charles R. Long, Jr. buys interests of Harry Vissering

Charles R. Long, Jr., president of the Charles R. Long, Jr., Company, manufacturers of railway and industrial paints, Louisville, Ky., vice-president of Harry Vissering & Company, manufacturers of railway supplies and equipment, and vice-president of the Okadee Company, manufacturers of locomotive specialties, Chicago, and also vice-president of the Viloco Machine Company, manufacturing machinists and engineers, Benton Harbor, Mich., has purchased the entire interest of Harry Vissering in the above companies and Mr. Vissering has retired from all of these companies. Mr. Long was born in Louisville, Ky., and after graduating from high school in 1888 entered business as secretary and treasurer of the Stratler Bros. Tobacco Company, Louisville, Ky., which position he held from 1890 to 1896. In the latter year he organized the Charles R. Long, Jr., Company to manufacture railway paints. In 1909 he also became one of the organizers of Harry Vissering & Company. In 1913 he was one of the founders of the Okadee Company and later became one of the incorporators of the Viloco Machine Company. In the reorganization of the Viloco Machine Company, Mr. Long, vice-president, has been elected president, with headquarters at Louisville, Ky. In the reorganization of the Okadee Company, S. W. Russell, formerly secretary and treasurer of the Charles R. Long, Jr., Company, with headquarters at Louisville, Ky., has been appointed vice-president; J. S. Lemley, formerly mechanical expert, has been promoted to vice-president, with headquarters in the newly opened office in the Railway Exchange building, St. Louis, Mo., and W. H. Heckman, formerly mechanical engineer, has been promoted to vice-president. In the reorganization of Harry Vissering & Company, G. S. Turner, formerly vice-president, has been promoted to president. A. G. Hollingshead, president of the Okadee Company, and S. W. Russell have been appointed vice-presidents and W. H. Heckman, mechanical engineer, and J. S. Lemley, mechanical expert, have been promoted to vice-presidents. In the reorganization of the Charles R. Long, Jr., Company, A. G. Hollingshead, president of the Okadee Company, will be vice-president, and S. W. Russell, secretary and treasurer, has been promoted to vice-president.

Charles R. Long, Jr.

Personal Mention

General

James King, superintendent of shops of the Pacific Fruit Express at Colton, Cal., has been transferred to Los Angeles, Cal., succeeding L. E. Martmill.

C. L. Buckingham has been appointed engineer of tests of the Missouri-Kansas-Texas, with headquarters at Parsons, Kansas, succeeding N. J. Boughton, who has been transferred.

W. F. Flynn, superintendent of motive power of the Michigan Central, has been transferred in a similar capacity to the New York Central, Lines East, with headquarters at New York.

J. Archie Jones has been appointed general air brake supervisor of the Delaware & Hudson, succeeding H. A. Flynn, resigned to enter the service of the New York Air Brake Company.

H. W. Faus, special engineer on the staff of the chief engineer of motive power and rolling stock of the New York Central Railroad, has been appointed engineer of materials and equipment tests, with headquarters at New York.

C. A. Garber, master mechanic of the Illinois Central, with headquarters at Memphis, Tenn., has been appointed mechanical superintendent of the Missouri Pacific, with headquarters at St. Louis, Mo., succeeding W. C. Smith.

F. G. Grimshaw, general superintendent of motive power of the Southwestern region of the Pennsylvania, with headquarters at St. Louis, Mo., has been promoted to works manager at Altoona, Pa., succeeding P. F. Smith, Jr., who has been granted a leave of absence from active duty owing to ill health. Mr. Grimshaw was born on November 26, 1878, at Paterson, N. J. He attended Cornell University, and entered railway service on January 9, 1902, as a special apprentice in the Pennsylvania's shops at Altoona, Pa. From March to May, 1905, he was motive power inspector at Altoona. He then became a yard clerk on the Pittsburgh division and in May, 1906, was promoted to assistant yardmaster. From August of the same year to June, 1907, he was assistant master mechanic of the Monongahela division. He then became master mechanic of the West Jersey & Seashore and served in that capacity until September, 1912, when he was appointed assistant engineer of motive power of the Western Pennsylvania division. In November, 1914, he became assistant engineer of electrical equipment of the Philadelphia Terminal division. He was appointed superintendent of motive power of the New Jersey division in July, 1917, and in May, 1918, was appointed assistant to the general manager at Philadelphia. In March, 1920, he became superintendent of the Eastern division and served in that capacity for a year, when he was appointed superintendent of motive power of the Eastern Ohio division at Pittsburgh, Pa. In June, 1924, he became general superintendent of motive power of the Southwestern region.

F. G. Grimshaw

C. W. Buffington has been appointed district boiler inspector of the Eastern General division of the Chesapeake & Ohio, with jurisdiction over all points east of Huntington, W. Va., including the Huntington shops. Mr. Buffington's headquarters are at Clifton Forge, Va.

J. F. Jennings has been appointed superintendent of motive power of the Michigan Central, succeeding W. H. Flynn.

F. P. Neesley, division master mechanic of the Michigan Central at Jackson, Mich., has been appointed assistant superintendent of motive power, succeeding J. F. Jennings.

Merle R. Reed, master mechanic of the Pennsylvania at Logansport, Ind., has been appointed assistant general superintendent of motive power of the Northwestern region with headquarters at Chicago. Mr. Reed was born on June 26, 1883, at Newton, Ill. He attended Rose Polytechnic Institute from which he was graduated in June, 1905. Previous to this time he had served during the summer of 1904 as a laborer in the Terre Haute shops of the Pittsburgh, Cincinnati, Chicago & St. Louis, a subsidiary of the Pennsylvania. After his graduation he returned to the Terre Haute shops as a signal repairman. A few months later he resigned to become a special apprentice on the Union Pacific at Omaha, Neb. He returned to the Panhandle in September of the following year as a draftsman in the Terre Haute shops. In June, 1907, he was promoted to assistant foreman and in February, 1909, became chief draftsman. In April, 1917, he was transferred to the Northwest System of the Pennsylvania, Lines West, as a general car inspector, and was promoted to superintendent of car repairs on the Pennsylvania, Lines West, in September, 1918. He was appointed master mechanic of the Eastern division in August, 1919, and when the administration of the Pennsylvania was reorganized in March, 1920, he was transferred to the Logansport division as master mechanic.

M. R. Reed

Master Mechanics and Road Foremen

W. B. Porter, assistant engineer of motive power of the Eastern region of the Pennsylvania, has been appointed master mechanic at Logansport, Ind.

W. F. Lauer, general foreman of the shops of the Illinois Central at Memphis, Tenn., has been promoted to master mechanic, with the same headquarters. Mr. Lauer was born on December 31, 1877, at Galion, Ohio. He attended the public and high schools at that place and on December 1, 1893, entered the employ of the Erie as a machinist apprentice at Galion. In December, 1897, he became a machinist on the Big Four at Bellfontaine, Ohio; in May, 1898, a machinist on the Lake Shore at Collinswood, Ohio; in January, 1899, tool foreman of the Erie at Galion; in January, 1904, machine shop foreman at Cleveland, Ohio; in January, 1908, general foreman of the Chicago & Erie branch of the Erie at Huntington, Ind., and in February, 1912, general foreman of the Illinois Central at Memphis.

W. F. Lauer

E. H. Carlson has been appointed acting master mechanic of the Montana division of the Northern Pacific, with headquarters at Livingston, Mont., succeeding R. P. Blake, who has been temporarily assigned to other duties.

C. L. GIBSON has been appointed master mechanic of the Stockton division of the Southern Pacific, with headquarters at Tracy, Cal., succeeding H. H. Carrick.

GEORGE H. LITTLEMORE, formerly an engineman on the Idaho division of the Northern Pacific, has been appointed road foreman of engines of the Montana division.

C. W. ADAMS, superintendent of shops of the Michigan Central at Jackson, has been appointed division master mechanic at Jackson, Mich., succeeding F. P. Neesley.

Shop and Enginehouse

G. W. DUNNING has been promoted to general foreman of the Southern, with headquarters at Columbia, S. C.

N. L. VAUGHN, roundhouse foreman of the Missouri Pacific at Lexa, Ark., has been transferred to Little Rock, Ark.

GEORGE M. GAGE has been promoted to enginehouse foreman of the Buffalo, Rochester & Pittsburgh, at East Salamanca, N. Y.

L. N. MCCARL, night foreman of the Honey Pot enginehouse of the Pennsylvania, has been promoted to day enginehouse foreman.

J. A. LASCH has been appointed roundhouse foreman of the Missouri Pacific, with headquarters at St. Louis, Mo., succeeding J. B. Crahan.

FRANK FOUSE, whose appointment as shop superintendent of the Lehigh Valley at Packerton, Pa., was announced in the March issue of the *Railway Mechanical Engineer*, was born at Martinsburg, Pa. He attended the Juniata College and in 1896 entered the employ of the Pennsylvania railroad. Mr. Fouse has since been in constant railway service with several leading railroads. His experience included seven years abroad, during which time he became master car builder of the London shops of the Grand Trunk railway. Prior to his entering the employ of the Lehigh Valley, he had been transferred as master car builder to the shops of the Grand Trunk at Montreal.


Frank Fouse

THEO. ROBERSON, foreman of the Waldo avenue enginehouse of the Pennsylvania, has been transferred as enginehouse foreman to Meadows, N. J.

P. A. SCHUBERT, gang foreman of the Northumberland enginehouse of the Pennsylvania, has been transferred to Wilkes-Barre, Pa., succeeding T. J. Parks.

T. J. PARKS, gang foreman of the Pennsylvania at Wilkes-Barre, Pa., has been appointed night foreman of the Honey Pot enginehouse, succeeding L. N. McCarl.

G. W. McElrea, assistant foreman of the Waldo avenue enginehouse of the Pennsylvania, has been promoted to enginehouse foreman, succeeding Theo. Roberson.

J. B. CRAHAN, roundhouse foreman of the Missouri Pacific at St. Louis, Mo., has been appointed general foreman locomotive shops, with the same headquarters.

G. G. DAVIS, superintendent of shops of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Beech Grove, Ind., has retired from active service.

C. J. BALFOUR, gang foreman of the enginehouse of the Pennsylvania, at Meadows, N. J., has been promoted to assistant enginehouse foreman, succeeding W. H. Oyer.

W. H. OYER, assistant enginehouse foreman of the Pennsylvania at Meadows, N. J., has been promoted to assistant foreman of the Waldo avenue enginehouse, succeeding G. W. McElrea.

H. H. CARRICK, master mechanic on the Southern Pacific, with headquarters at Tracy, Cal., has been promoted to superintendent of shops at Los Angeles, Cal., succeeding W. A. Rogers, deceased.

H. D. CARPENTER, motive power inspector of the Panhandle division of the Pennsylvania System, has been appointed enginehouse foreman of the Ohio River & Western, with headquarters at Zanesville, Ohio.

W. R. BENSON, superintendent of shops of the Michigan Central at St. Thomas, Ont., has been appointed superintendent of shops at Jackson, Mich., succeeding C. W. Adams. Mr. Benson was born in 1889 at St. Thomas, and was educated in the public and high schools of that city. In 1906 he entered the employ of the Michigan Central as a machinist apprentice, serving in this capacity for four years. He then worked in several manufacturing plants at Detroit, Mich., and for the Canadian Pacific at Toronto, Havelock, MacTier and London, Ont. Re-entering the employ of the Michigan Central at St. Thomas in July, 1913, he served consecutively as piecework inspector, general piecework inspector, erecting shop foreman, general roundhouse foreman, assistant general foreman, general foreman and superintendent of shops.

Purchasing and Stores

W. F. SANFORD has been appointed district storekeeper of the Chicago & North Western with headquarters at Green Bay, Wis., succeeding W. F. Redman, promoted.

E. H. LEHMAN, general storekeeper of the Ohio Central lines of the New York Central, has been appointed assistant general storekeeper, with headquarters at Columbus, Ohio.

J. C. MACDONALD has been appointed district storekeeper of the Southern district of the Chicago, Milwaukee & St. Paul, with headquarters at Dubuque, Iowa, succeeding G. T. Richards.

J. P. MURPHY, general storekeeper of the New York Central, lines west, with headquarters at Collinwood, Ohio, has been given jurisdiction also over the Ohio Central lines, with the same headquarters.

E. J. LEONARD, division storekeeper of the Chicago & North Western at Clinton, Iowa, has been transferred to the Iowa division, with headquarters at Boone, Iowa, succeeding F. H. Fick, promoted.

G. T. RICHARDS, district storekeeper of the Southern district of the Chicago, Milwaukee & St. Paul, has been transferred to the Northern district, with headquarters at Minneapolis, succeeding J. T. Kelly.

W. B. HALL, general storekeeper of the Denver & Rio Grande Western, with headquarters at Denver, Colo., has been promoted to general purchasing agent, with the same headquarters, a newly created position.

J. T. KELLY, district storekeeper of the Northern district of the Chicago, Milwaukee & St. Paul, with headquarters at Minneapolis, Minn., has been appointed chief stockman, with headquarters at Milwaukee, Wis., succeeding H. L. BRILLINGER, deceased.

Obituary

WILLIAM A. ROGERS, superintendent of the general shops of the Southern Pacific at Los Angeles, Cal., died on March 18. Mr. Rogers was born on December 25, 1874, at Brantford, Canada, and in 1887 entered the employ of the Grand Trunk, now the Canadian National, as a machinist apprentice. Upon completion of his apprenticeship, he traveled extensively, visiting various parts of the United States, Canada and Mexico. About 1893 he joined the construction forces of the New Orleans & North Eastern railroad. The following year he became master mechanic, handling much of the material used for the extension of the line across Louisana and Mississippi. About 1895 he was air brake and compressor mechanic of the Southern Pacific at Wadsworth, Nev.; about 1897 or 1898, machine foreman of the Oregon Short Line at Pocatello, Idaho, and in 1898 employed by the Prescott & Eastern railroad at Prescott, Ariz. In 1905 he entered the employ of the Los Angeles & Salt Lake, now the Union Pacific, serving consecutively as machinist; general foreman at Los Angeles, Cal., and master mechanic at Las Vegas, N. M. In September, 1914, he became general foreman of the Los Angeles shops of the Southern Pacific; and in October, 1917, superintendent of shops.

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Railway Mechanical Engineer

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Training in the art of leadership

The article or study on "Training foremen in leadership" in this issue, is based upon observations of the editorial staff of the *Railway Mechanical Engineer* and replies to a letter which was sent to the heads of the mechanical departments of the more important railroads in the United States and Canada. So much interest has been shown in this problem of helping the foremen and supervisors to perfect themselves in the art of leadership, that an attempt was made to round up the practices looking toward this end on all of the railroads. The study cannot be said to be complete, for it is apparent that not all of the officers who replied to our letter fully covered all of the things that they are doing to inspire and help the foremen to develop their leadership ability. It is surprising, however, to note the many different things that are being done. Other important developments are being tried out on some roads which are still in a more or less experimental state and which we are not permitted to divulge at this time. The big thing is that the railroad managements are awakening to the importance of this question and that the foremen themselves appreciate the situation and are keen to take advantage of anything that will help them to get better results.

The *Railway Mechanical Engineer* is always glad to hear from its readers, but we would particularly appreciate any suggestions from you concerning constructive steps which are being taken on this problem, which are not mentioned in the article or are not fully covered by it. We should like to know also, for instance, what particular thing has been most helpful to you in securing a better understanding of how best to direct and lead the men in your charge. Have you found some book or method or principle or agency particularly helpful? If so, tell us about it.

How much is a machine tool worth?

As the reader turns over the pages of the section devoted to new machine tools and devices he will find many machines and tools that will increase shop output. The question is, however, how do we determine their real worth? We can arrive at a certain figure by considering the quantity and quality of metal in the machine or we can estimate the cost to the manufacturer to build it. This method will, in principle, be somewhat akin to a story which was told recently by the master mechanic of a large shop on one railroad in the East.

Once upon a time, as all good fairy tales begin, there was an employer who paid his men according to their weight; in other words, the heavier a man weighed the higher the wage. Evidently the work was of such a nature that size and brute strength were the chief assets. As the business expanded the employer hired another assistant. The salaries of the two men were fixed according to their weights. It so happened that the small man was quite keen in working out clever schemes and kinks for improving production, while the larger man relied solely upon brute strength. The employer was forced to change the basis of wage payment.

There are many machine tool users who are inclined to estimate the worth of a machine from the standpoint of so much iron and steel or by what it cost the manufacturer to build it. But a mass of iron and steel cannot be made into a machine without first being organized in the mind of the designer.

The equipment produced today by the machine tool builders is the result of a process of evolution through an endless variety of mechanical apparatus designed to meet the needs of the time. It is the product of many years of experience, research and experiment. Brains has been the most important factor in the development of the modern machine tool, and it is constantly becoming better and more efficient. From the standpoint of the user the worth of a machine depends upon how much better and cheaper it can produce its product than other machine tools used for the same class of work.

The foreman's job

It has been said that the greatest undeveloped asset on a railroad is the human element. Two factors are necessary to release this great possibility—a broad and wise policy on the part of the management in dealing with its employees, and a capable, well-trained body of foremen and supervisors who can interpret the management to the men and lead them in a wise and tactful way, so that they may be developed to the limit of their capabilities. Morale is all-important in any organization. Experts who have been planning in recent years to bring the morale in the army to the highest possible standard have adopted as a slogan. "The army builds men." The meaning or intent of this is that each man is critically analyzed and studied, and is assigned to that class of work for which he is best suited and so directed that he will make the best possible use of the disposition and talents with which he is endowed. It is just as important to do this in an industrial or railroad organization as it is to do it in the army. No two men are alike. They differ widely in their likes and dislikes and in their individual characteristics. They will be happier and will give better service if they are used on that work for which they are best fitted by nature and if they are encouraged and trained so that the best use may be made of their peculiar characteristics.

This is no small task. It means that the foreman must be a keen student of human nature and must study how to deal tactfully and wisely with the most complicated and

sensitive of mechanisms—the human being. Some foremen and supervisors are succeeding in doing this in a big way. The author of the first prize article in the *Railway Mechanical Engineer* contest on the "Opportunities and possibilities of the Foreman," which appears elsewhere in this issue, is an outstanding example. We regret that we cannot use his real name, but his article more or less clearly reflects his personality and methods. It is worthy of the most careful thought and study, particularly if it is read in conjunction with the article on "Training foremen in leadership," which also appears in this number.

Incidentally, the prize article offers much in the way of suggestion for discussion topics at foremen's meetings and staff meetings. Do you agree with "Bill Brown?" Have you gone him one better in some respects? Can his suggestions be applied to your conditions? Has he overlooked or understated important principles? The *Railway Mechanical Engineer* will also be glad to have your reactions.

Terminal maintenance of passenger cars

The terminal maintenance of passenger equipment is one of the big problems of the car department, particularly at those terminals which handle a large volume of suburban traffic. A survey of the methods of handling a large number of units of equipment at terminals indicates that proper facilities and organization are woefully lacking. The location of the storage tracks, adequate facilities for making repairs, the right kind of organization for handling repairs, and the proper analysis of the terminal operating conditions are factors that must be given careful consideration in order to handle passenger equipment economically and with dispatch.

At the modern locomotive terminal the trackage is so arranged so as to reduce to a minimum the amount and the distance of the movements to get locomotives in and out of the terminal. Such is not generally the case with passenger cars at terminals. The storage tracks are usually a considerable distance from the terminal, which results in high shifting costs owing to the time and distance required to move equipment. This cannot be remedied over night but should be kept in mind when planning future terminal layouts. The operating conditions at a locomotive terminal are carefully analyzed so that the locomotives are quickly serviced and ready for their runs without any unnecessary delays. The operations at a passenger terminal afford the mechanical officers an unusual opportunity to make a graphic analysis of the arrival and departure of equipment so that each unit can be properly maintained without withdrawing it from service. In other words, the cars should be withdrawn from service after the morning peak traffic load, repaired during the day and put back in service to handle the evening rush hour traffic. The practice will reduce to a minimum the number of cars required to handle the traffic and will increase the car miles between shoppings.

In order to repair the cars between the morning and evening rush hours, the proper repair facilities must be provided convenient to the terminal. Proper facilities should also be provided for cleaning the cars and repairing trucks and wheels. A modern drop pit should be placed as convenient as possible to a wheel lathe. The usual practice is to have a large number of extra wheels on hand ready to replace worn ones; the removed wheels are then loaded on cars and sent to the nearest wheel lathe for repairs. This practice is expensive—a considerable amount of capital is tied up in extra wheels, to say nothing of the expense involved in transporting them to and from the repair shop. The location of a drop pit and a wheel lathe at the terminal will eliminate this expensive operation.

In the final analysis, the principal object of the plan of terminal operation outlined above is to increase the length of time between the shopping of cars, and in doing so, keep the number of cars going to the repair shops to a minimum.

The importance of knowing detail costs

Under the present system of accounting usually from 30 to 40 days elapse after the close of each month before the master mechanic knows the cost on his division per locomotive mile for repairs, lubrication, enginehouse expense, fuel, etc.—that is, if he waits for the various reports to be forwarded to him from the accounting department. From the standpoint of efficient shop management such figures are of comparatively little value for about the only way a master mechanic can ascertain whether his shop costs are increasing or decreasing is by personal investigation and inspection. Unless he has the results of a similar investigation to refer to, made at the time of the last report, an investigation made 30 or 40 days after the time to which the figures refer will avail little. The only way by which the master mechanic can have his cost figures when he needs and can use them is by getting them himself.

Cost finding is a complex matter at best and as railroad shops grow to greater proportions, this complexity will increase in like ratio. The methods and approximations which may be adequate for a small shop, cannot be relied upon when the plant becomes so large that personal observation by the master mechanic or shop superintendent is insufficient. In many railroad shops, where so-called cost systems have been installed, the cost system is considered satisfactory if it simply shows the cost of performing a certain class of repairs. But the modern conception of a cost finding system is much more exacting. Such a system should show costs in such a form that deductions may be drawn as to the reasons for them and the possibilities of reducing them.

A system of this kind would undoubtedly require a considerable increase in the office force of the master mechanic, but a cost-keeping system that simply records costs for the purpose of knowing the expenditures made, say for a given class of repairs, has accomplished only a small part of its mission. Efficient shop management requires a knowledge of the activity of each department so that the master mechanic or shop superintendent can take proper steps when necessary to apply remedial measures.

It is not only true of the railroads, but of other industries as well, that the art of cost finding is still in a crude and undeveloped stage, so far at least as individual detail costs are concerned. That there is a growing appreciation of the importance of cost finding among mechanical department officers is evidenced by the extensive installation of shop scheduling systems in which repair costs are taken into account and the recent studies made by various roads as to the utilization of money appropriated for repair work. A recent example of where the money expended for repair work has been made the fundamental factor of the shop administration is at the Finley shops of the Southern Railway, Birmingham, Ala. A description of the locomotive unit was published in the March issue of the *Railway Mechanical Engineer* and the car shops are described elsewhere in this issue. Both shops are under the same administration and real progress has been made during the short period they have been in operation, by proper control of labor and material expenditures.

The system at the Finley shops, however, as well as in

the majority of other shops throughout this country where cost systems are in operation, does not deal with the finding of the detail costs. The knowledge of what it costs per locomotive mile for repairs, enginehouse expense, etc., will possibly arouse the master mechanic to action if his costs are too high in comparison with those of other divisions. But figures showing only general or summarized costs are of little practical benefit to the master mechanic or shop superintendent if he wants to know where the money is being spent to the least advantage. He must have available more detail data.

Planning for the future

Complaint is frequently voiced against the treatment received by mechanical department budgets at the hands of the executives responsible for capital expenditures. To some extent the lack of sympathy with the plans of the mechanical department for improving its facilities is the result of the position of the mechanical department in the railroad organization because it is primarily a spending and not an earning department. Locomotives and cars are the tools of the railroad by which it produces the ton-miles and passenger-miles from which the revenue of the road is derived. The value of these facilities and of improvements in them which will increase the ratio of revenue-producing capacity to the cost of their operation is much less difficult of appreciation by the executive than is the value of machine tools, ash and inspection pit facilities or modern drop pit, boiler washing and material-handling facilities which in the mind of the executive are not primarily connected with the production of transportation. The details of their operation are incomprehensible to the average executive and he is not interested in them.

It is a question, however, whether the executive is entirely responsible for the viewpoint with which he approaches the consideration of requests for appropriations to provide these facilities or to replace those which have outlived their usefulness with modern units capable of reducing maintenance costs and increasing equipment capacity by keeping it in service for a larger percentage of the time. Is not the mechanical officer himself in a measure responsible for this situation?

Many mechanical department budgets present to the executive a long list of details, each machine tool or other facility representing in effect a separate project with its own explanation and justification which goes into details of shop operation in which the executive is not interested and to which he cannot give the necessary attention to arrive at a thorough comprehension of the possibilities or of how each detail dovetails into the complete equipment maintenance structure. The entire budget is thus open to attack piecemeal. On the other hand, a grade revision program is presented as a whole and a bridge here or a signal there are details which must be accepted if the project as a whole is accepted.

Is not the mechanical department suffering in a measure from a lack of a comprehensive survey of its needs and possibilities? Is there not an opportunity for a complete survey of the situation as a whole on each road and the formulation of a program of improvements which not only meets the immediate requirements but looks ahead to the ultimate development of completely co-ordinated facilities to form a plant from which the maximum equipment serviceability may be obtained from a minimum expenditure per equipment unit? Such a program, it is true, will call for the expenditure of millions of capital instead of thousands, but it will present a comprehensive and comprehensible picture to the executive. The results can be measured in more serviceable locomotive-hours and in decreased cost of locomotive and car maintenance per unit of service, which means far more to the executive than, for instance, a saving of a few minutes or even a few hours in machining a crank pin or valve chamber bushing by the installation of a new turret lathe or a new boring mill.

The results of a complete program of rehabilitation, carefully worked out to facilitate the extension of locomotive runs, for instance, which the operating department may have in mind, have a direct appeal to the executive which will at least lead to sympathetic consideration and meet with less opposition than would an unco-ordinated list of tools and other facilities. A project requiring the expenditure of ten million dollars, carefully spread over a period of say ten years, resulting in improved equipment utilization and decreased costs which could be measured in terms of their effect on the operating ratio would probably be less difficult to put over than a one hundred thousand dollar project for ten or fifteen new machine tools, each of which would amply justify itself, but the results of all of which together could hardly be found in the operating ratio. The mechanical officer of vision and enterprise has a big opportunity at least to put himself and his department in a position to command the attention and respect of his executive, and in some cases even of his board of directors.

What Our Readers Think

Supply salesmen should read this letter

[The writer of the following letter asked that his identity be concealed]

To the Editor:

There is, I believe, no one in charge of a railroad shop more interested in the supply salesmen and their wares than the writer, who thinks he has learned more of the progress of inventions and what improvements are being made in the interest of shop production from these men than perhaps from any other source, except it be from the advertising and other pages of the mechanical journals.

In view of this belief, his office door is always open to them and he is never too busy to discuss with them the goods they wish to call attention to. As a class, they are above the ordinary man in specialized knowledge and whoever thinks he knows more than these men, has probably overlooked something that would be to his own advantage and material interests. All of which is merely mentioned to show his attitude towards mechanical salesmen as a class. However, the following interview took place recently in his office and is submitted in the hope that it will reach the attention of the class of men he is so partial to and that it will be of benefit to them:

"Good morning, Sir. Are you Mr. B———, superintendent of these shops?"

"Yes sir."

"Well I am representing the ——— Tap Company. We make the finest line of taps made. Our stay bolt taps are a specialty with us. They have become standardized on the X.Y.Z. railroad, after severe competitive tests. I have also conducted tests on the A. B. C. and on the P. D. Q. railways with excellent success and have proved our taps to be better than our competitors'."

"Well, that is quite interesting. How do you mean they proved themselves to be better? Were yours high speed steel and the other fellows' carbon?"

"No sir. They were all carbon steel taps but we tapped more holes than the other fellows."

"How many holes did you tap before they failed?"

"Well, I did not keep tab on the number of holes tapped but ours did the most holes."

"Don't you think it it would have been valuable data to have the number of holes each tapped?"

"Well, it might be."

"What was the thickness of the boiler plate you were tapping?"

"Oh! The usual kind of fire box plate. I did not measure the thickness. But it was the same thickness for all the taps tested."

"What revolutions per minute were the taps used at?"

"Why, as fast as the motors would run."

"You do not know the r. p. m. then, at all?"

"No, I did not think that was necessary."

"What make of air motors did you use? Perhaps we can find out the r. p. m. from that information if you have the air pressure used."

"I do not know the air pressure but one motor was a Little Giant, I think they call it. I do not know the make of the others."

"Well, were they all the same make?"

"I am not sure of that."

"What lubricant did you use on the test?"

"Well, I do know that, it was a heavy oil."

"What kind of oil?"

"A very heavy dark colored oil they put on with a paint brush."

"But you have no idea just what oil it was?"

"No sir. I did not think that made any difference."

"In your traveling around with these stay bolt taps, what lubricant do you find the most used when tapping stay bolt holes?"

"I never took any particular notice of them."

"You say your taps beat the other makes in number of holes tapped. Just what do you attribute it to, that they proved able to tap the greatest number of holes before failing?"

"Well our factory uses the greatest care in selection of steel and they have a special method of tempering them."

"Are the threads of your taps ground or cut in the lathe?"

"I don't know just how they are threaded. But I do know they grind them after they are threaded."

"What make of taps were those you tested yours against?"

"Well, we salesmen do not make a practice of naming our competitors' goods when talking to prospective customers."

"But you did get the names of them, did you?"

"Oh, yes!"

"Well let me tell you a few things without intentionally hurting your feelings at all. I must say you have yet much to learn before you become a successful salesman. You were, according to the ethics of your business correct, I suppose, in not mentioning the names of your competitors' goods to me. At least, I believe that is what the sales managers teach, although I do not know exactly why. That much you appear to have learned thoroughly. But how much more welcome you would be in here were you able to give me more particulars of your test. To tell me that the speed was, say, 250 r. p. m., through Luken's or Otis' or some other brand of ⅜-in. fire box steel. That paraffine oil was first used but that the taps all appeared to get rather hot and that white lead was tried with good results. That the best one tapped 2,180 holes and the next one 2,000 and the other one 1,860. That the reason you believe your tap to be the best was because your company was continually making tests in the factory. That one tap out of each batch, picked at random had to go through so many holes at such a speed before the others were sent out. That you had spent considerable time in the factory watching the process of manufacture and the expert care exercised to get them the correct size and temper. To explain the Brinell testing of them, stating that while ground taps may last somewhat longer and would cut a more accurate sized hole and are an excellent tap where interchangability is necessary, still for boiler work, the taps threaded in the lathes are quite practicable enough and cost much less.

"That there appears to be a great variance of opinion as to which is the best lubricant to use but from your own personal observation, leaving out the cost of it, a mixture of white lead and linseed oil in certain proportions gave the greatest number of well threaded holes per tap. That the r. p. m. varies all the way from 100 to 275 in different localities. That in some places where they practice electric welding for closing up the old holes of the fireboxes no make of tap will successfully stand up, where owing to high voltage or other causes, the hole has been made almost as hard as the tap itself. Now I am sure you will take this advice from an old salesman in the spirit it is given. Take this pass out to the boiler shop and ask the foreman for all the information on taps and tapping he can give you. I will call him on the phone and tell him to look out for you. Good-bye and good luck to you. Well, thanks, I'll take one, I don't smoke myself but will give it to my chief clerk. Call again some day."

SHOP SUPERINTENDENT

Wear of cross-compound compressor cylinders

MILWAUKEE, Wis.

TO THE EDITOR:

In the April, 1925, *Railway Mechanical Engineer,* page 200, there was an inquiry from R. J. K. for an explanation as to why the air cylinders of the 8½-in. cross-compound air compressor do not have the greatest wear at the same points on the cylinder walls as the 9½-in. and 11-in. compressors.

While it is possibly true that under certain conditions the wear of the high-pressure air cylinder of the cross-compound compressor will be different from that of the 9½-in. or 11-in. compressors, the low pressure air cylinder will be found to wear exactly the same as those of the other compressors; that is, the least wear of the cylinder wall will be found at the center of the piston stroke.

The excessive wear near the ends of the cylinder is caused by the packing rings being pressed harder against the cylinder wall as the compression of the air increases toward the end of the piston stroke. The cylinder walls of all air compressors should wear more at the ends than in the center on account of the increased friction of the rings. The cylinder wall of the high-pressure cylinder of the cross-compound compressor will also wear in this manner if the compressor is properly balanced, but it should be borne in mind that it cannot be properly balanced for all main reservoir pressures. For illustration, if properly balanced when operating with 200 lb. of steam against 100 lb. main reservoir pressure, it would be out of balance when operating against 130 lb. main reservoir pressure for the reason that the high-pressure steam piston, with 200 lb. steam pressure, can only compress the air in the low-presure air cylinder to approximately 40 lb., all further increase of pressure being accomplished by the low-pressure steam, high-pressure air piston. When the cross-compound compressor is operating against low main reservoir pressure, the low-pressure steam, high-pressure air piston will complete its stroke to the end of the cylinder, but when the main reservoir pressure is high, this piston stops a greater or lesser distance from the end of its stroke.

The low-pressure piston is a floating piston and is in no way connected to the valve mechanism. When this compressor is in a service which requires high main reservoir pressure, such as passenger service where 110 lb. brake pipe and 130 lb. main reservoir pressures are standard, there will be very little wear of the cylinder wall at the end close to the counterbore. The greatest wear, however, will not be in the center as stated by R. J. K., but a certain distance back of the counterbore. In other words, this cylinder will wear in the same manner as those of the other compressors within the zone of its piston stroke. When calipering this cylinder it will be found that the smallest diameter is near the counterbore, the next larger diameter at the center and the largest diameter a short distance from the counterbore.

The low-pressure steam, high-pressure air piston stops before completing its full stroke because of the by-pass grooves which are placed in both ends of the low-pressure steam cylinder. There are three by-pass grooves machined in each end of the low-pressure steam cylinder wall, each groove is 2 in. long, ⅝ in. wide and 3/16 in. deep. When the piston, operating against high main reservoir pressure, uncovers these grooves, the steam escapes and the piston stops, with the result as before stated.

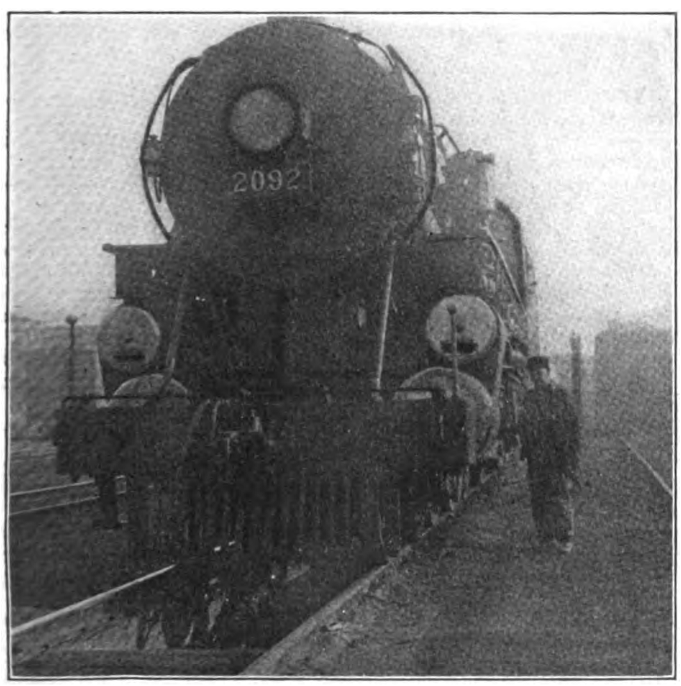
JAMES ELDER,
General air brake supervisor, Chicago, Milwaukee & St. Paul.

Lehigh Valley engine terminal at Sayre, Pa.—The system locomotive shops can be seen in the background

Assignment of locomotives for enginehouse repairs

Re-organized forces and co-operation increase efficiency of Lehigh Valley engine terminals

ENGINE terminal running repair practice has always been considered an entirely different problem from locomotive shop work, owing to the necessity of taking into consideration the unexpected element of emergency situations. A terminal which can anticipate the unexpected and be in a position to provide power for emergency requirements at times of peak traffic without disrupting the despatching schedule is indeed unusual. And yet, this apparently can be attained by departing, in some respects from usual engine terminal practice and intelligently applying a successful feature of modern back shop practice; namely, specialized gangs and assigned work. While the following article deals entirely with the application of this principle at the Sayre, Pa., engine terminal, the same operations are standard at all other terminal enginehouses on the Lehigh Valley.



Inbound inspection pit—Note the nickel plated head casings on the passenger locomotive

The Sayre engine terminal is one of the most important on the Lehigh Valley. The operations at this terminal present a most interesting example of the value of thoroughly analyzing operating conditions and then inaugurating practices to improve them which constitute a radical departure from established precedent. This terminal is located at approximately the mid-point between Buffalo, N. Y., and New York City and despatches power for slow and fast freight, passenger, milk and yard service. During the twelve months period ending March 31, 1925, this terminal despatched an average of 3,580 locomotives per month for all classes of service, an average of 118 for each 24-hr. day. The maximum number of locomotives despatched during any one month in that period was 4,013 during October, 1924, an average of 130 per day.

Slow freight power is despatched for runs to Manchester, N. Y., on the west and Coxton, Pa., on the east. Power for milk and fast freight service is despatched from Sayre to Lehighton eastbound, a distance of 152 miles; for main line passenger and fast freight service from Sayre to Buffalo, N. Y., westbound, a distance of 176 miles, and for passenger service from Sayre to Easton eastbound, a distance of 194 miles. Sayre is the home repair terminal for most of the power despatched. Most of the locomotives are used on turn-around runs, only inspection and light running repairs being made

during the lay-over at the outlying terminals. For example, in main line passenger service one locomotive running on a through passenger train from Sayre to Buffalo is handled on consecutive days by three crews, each of which in turn makes a turn-around run from Sayre to Buffalo and return, a distance of 352 miles in 24 hr.; between Sayre and Easton, locomotives handled in the same way make 388 miles in 24 hr. Passenger locomotives on these runs will average from 10,000 to 12,000 miles per month.

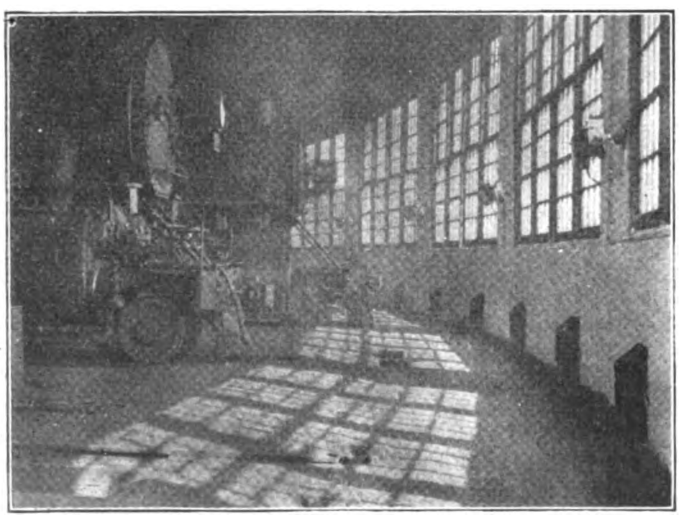
For some time past the Lehigh Valley, particularly on the Seneca division, has made a practice of complete assignment of power to road crews in all classes of service and has found that this method of handling locomotives has distinct advantages over the practice of pooling power. All regularly assigned engine crews have assigned locomotives and an extra board is maintained to cover jobs created by regular men laying off, and extra trains, such as special or work trains. If an extra job is boarded for five or more consecutive days, it becomes a regularly assigned job with an assigned locomotive.

The Sayre engine terminal consists of a 40-stall brick enginehouse and an annex shop with 10 repair tracks served by a transfer table. Owing to the fact that the annex shop is of comparatively old construction, it has not been possible to provide overhead crane facilities without the necessity of making expensive building alterations. Therefore, in order to handle the heavy modern power adequately a 200-ton Whiting locomotive hoist was installed. The annex machine shop is equipped with machine tools as follows:

2 Vertical boring mills.	1 Slotter.
1 Horizontal boring mill.	2 Shapers.
3 Drill presses.	1 Hydraulic press.
1 Turret lathe.	3 Emery grinders.
2 Planers.	1 Steam hammer.
1 Wheel lathe.	1 Power hack saw.
11 Engine lathes.	

Re-organized plan of operation

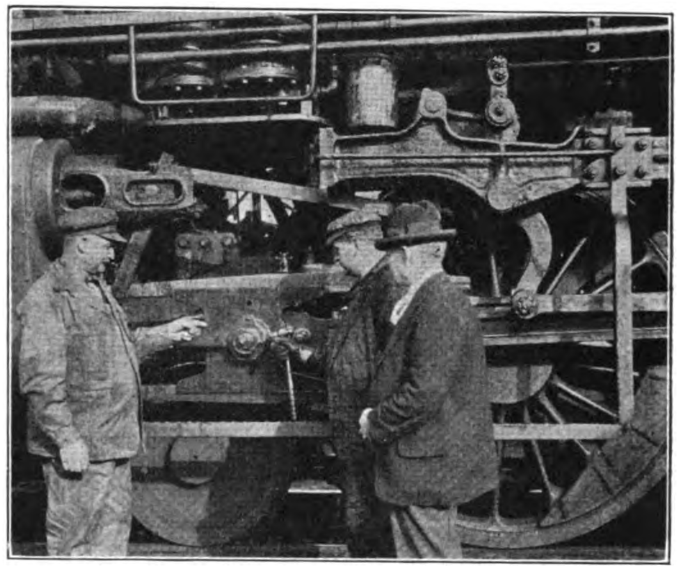
The realization of certain advantages gained from assigned power raised the question in the minds of mechanical department officers as to why these advantages might not apply in a different way to the methods of handling repair work at the engine terminal. As a consequence, after a careful study of conditions, a complete re-organization of forces was made at the Sayre engine terminal in the early part of 1924 and a new system of handling running repairs, which is described in this article, was put into effect about April 1, 1924.



Flood lighting in the enginehouse facilitates night work

In general, the controlling factors of the re-organization of the terminal forces are as follows:

1—The regular assignment of all locomotives and engine crews.
2—The assignment of locomotives to regular enginehouse mechanics for maintenance.
3—A definite assigned list of serviceable locomotives:
(a)—Locomotives assigned to regular crews.
(b)—Locomotives assigned extra to replace regular locomotives withdrawn for repairs or to handle emergency business. Under this classification there are eight serviceable locomotives assigned at all times, four for the eastbound board and four for the westbound board.

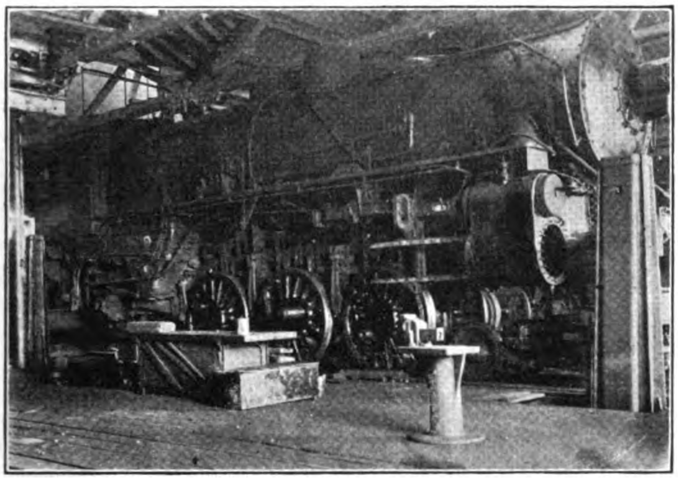


Co-operation between road and shop men has raised the maintenance standard

4—Enginehouse forces handle and despatch only serviceable power.
5—Enginehouse forces handle no heavy work and there is no despatching of locomotives on anticipated repairs.
6—The complete separation of enginehouse forces into two groups:
(a)—Forces to handle despatched serviceable power.
(b)—Forces to handle heavy repairs and to maintain and provide serviceable locomotives for regular assignment.
7—Division of stalls in the enginehouse with specified pits and repair forces for certain classes of power:
(a)—Stalls Nos. 1 to 20, inclusive, for freight repair forces handling serviceable heavy power.
(b)—Stalls Nos. 21 to 32, inclusive, for heavy repair forces, handling all washouts and locomotives withdrawn from service for general maintenance. In order to facilitate the handling of heavy repair work, pits Nos. 21 to 32 were selected because of their close proximity to the annex machine shop and enginehouse storeroom.
(c)—Stalls Nos. 33 to 46, inclusive, are assigned to passenger and light power forces, handling passenger, light freight and yard locomotives.
8—The inauguration of regular meetings of the engine terminal supervisory forces on the following schedules:
(a)—Daily meetings held at 8:00 a. m. to discuss the handling of schedule work, despatching of power, emergencies, detentions and discipline.
(b)—Weekly meetings to discuss the scheduled withdrawal of locomotives for the following week, defining the work to be done, this work being determined by special inspection; the scheduling of washouts, and general discussions.
(c)—Monthly meeting for the discussion of work scheduled for the following month, at which time all heavy work is determined for the enginehouse heavy repair forces, including locomotives to be shopped in the annex and locomotives to be sent to the system shop, which is located at Sayre. The division road foremen of engines attend these regular monthly meetings in order to discuss with the master mechanic and engine terminal supervisors the work which should be done on locomotives as discovered by them on the road.

In many modern engine terminals the tendency has been in recent years to have specialized gangs look after

certain well-defined classes of repair work. This is in line with the common practice of classifying and specializing repair work in locomotive shops. The important difference in the organization methods described here lies in the fact that there are not only specialized gangs in the engine terminals, but that to each gang is assigned



Wheeling a heavy Pacific type locomotive on the 200-ton hoist in the annex

a definite number of individual locomotives for the maintenance of which they are solely responsible.

Enginehouse organization

The general enginehouse foreman who reports directly to the master mechanic has under him two general foremen, one responsible for all repair work in the enginehouse, and the other in charge of the annex shop. In addition to these two general foremen, the boilermaker foreman and the labor foreman report directly to the general enginehouse foreman.

Reporting directly to the general foreman in charge of the enginehouse proper are four gang foremen in charge of the following work:

1—All heavy repair work on locomotives out of service, which are being handled in stalls Nos. 21 to 32.

2—All running repair work on serviceable passenger power, which are being handled in stalls Nos. 33 to 46.

3—All running repair work on serviceable freight power, in stalls Nos. 1 to 20.

4—Specialty foreman in charge of gangs assigned to air brake work, booster maintenance, stoker maintenance, flange oilers and drifting valves, lubricators and superheater damper cylinders, all pipe work on live and dead power, repairs to air reverse gears on live and dead power, all cab valve work, setting safety valves and boiler inspection certificates, and electric headlight maintenance.

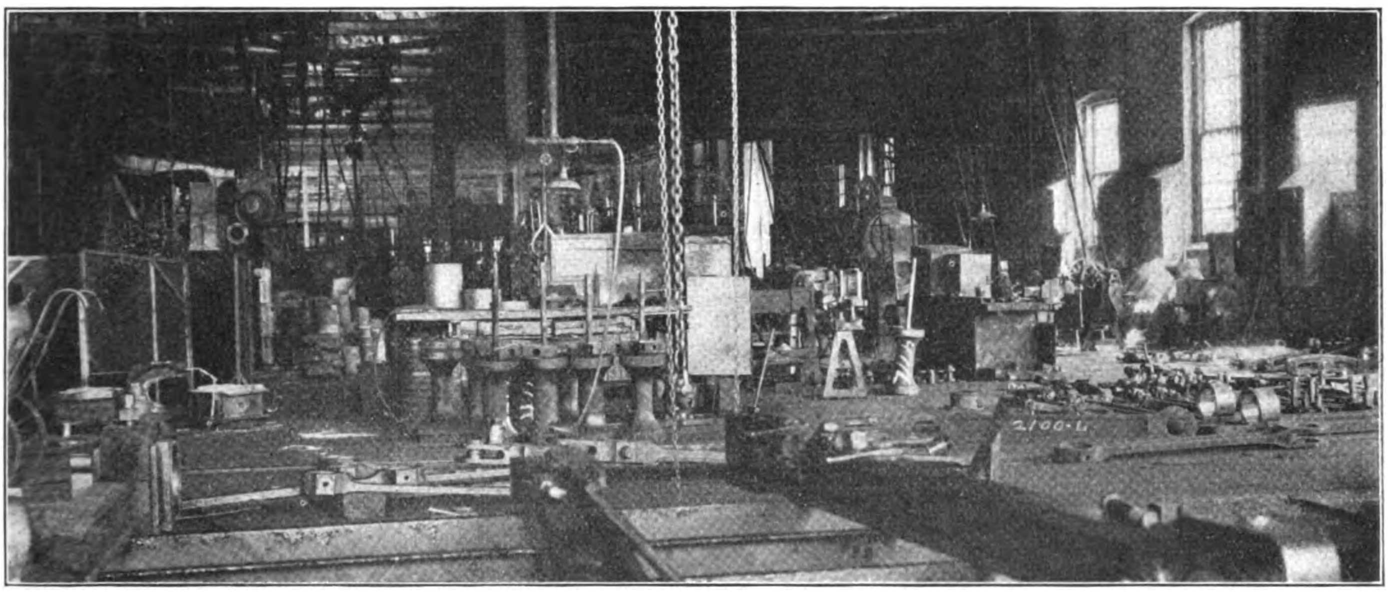
Every effort is made to increase the time locomotives are available for service and this system has made it possible to effect an appreciable reduction in the time required to repair a locomotive. Likewise, a very close check is kept on the matter of terminal delays.

Terminal inspection and maintenance records

When a locomotive comes into the terminal after a run it passes over an inspection pit on the inbound track. This pit is 160 ft. long and is provided with electric lights to facilitate the inspection of inaccessible parts of the running gear at night. The inbound inspector makes a report on the same blank form as that used by the engineman, and copies of this report are furnished, together with the engineman's report, directly to the gang to which that particular locomotive is assigned. While all foremen receive copies of work reports for locomotives which are maintained by the gangs under their supervision the fact that each gang knows exactly what work is expected of it on certain assigned locomotives relieves the foreman of the necessity of assigning work slips.

As previously mentioned, the gangs handling the running repairs on live serviceable power in the enginehouse work only on serviceable power, for as soon as a locomotive is scheduled for repairs sufficiently heavy to require its withdrawal from service, it is immediately transferred to the heavy work section of the house or to the annex shop. In this way repair work is concentrated, there being no dead engines in the two sections of the house assigned to serviceable power. All washouts are handled in the heavy work section, and the washouts are so scheduled that they are made on week-days only, any locomotives on which the washout date falls on Sunday are scheduled to be washed before that day.

The value of complete maintenance and running repair records is appreciated and regular reports are distributed among the supervisory forces such as those covering the daily, weekly and monthly meetings. One report par-



View at one end of annex shop

ticularly which seems to be worthy of special mention is a set of two records which are kept on driving box grease consumption. One of these is a daily record showing that an inspection has been made of each driving box on each locomotive, and if it has been necessary to apply grease, a record of the amount of grease is entered in the column of the report showing the particular driving box to which the amount of grease was applied. This daily report is filled out for all locomotives despatched during the 24-hr. period. The second form provides a monthly record of grease consumption for each individual locomotive, the information for which is transferred from the daily report. Both reports show the mileage made by the locomotive. These records have enabled the master mechanic to keep in very close touch with the hot journal situation, as it can readily be seen that if the report indicates that any particular driving box on a certain locomotive is requiring more than a normal amount of grease, it is an indication that attention is required. In this way it is practically always possible to anticipate "hot journal" trouble and remove the cause before it becomes serious.

Scheduling heavy repairs

A scheduling system for the annex repair shop has been installed which is remarkably simple in operation and requires very little work on the part of the supervisory forces to keep it posted. The forms used in connection with this schedule system are shown in Figs. 1 and 2. When a locomotive is placed in the annex shop for repairs, the work to be done on it is determined by a special inspection and a special work report is furnished to the general foreman in charge of the annex. The form shown in Fig. 1 shows the various items of work to be performed by the different departments on each consecutive day while the locomotive is in the shop. The general foreman of the annex shop indicates on this form each morning whether or not all work which is scheduled for that particular date has been done. For example, the form shown in Fig. 1 is filled out and it

Driving Box Grease Consumption -- Individual Engine Record
Sayre Enginehouse

Eng. No. 2092 Month of March 1925

Date	Box R-1	Box R-2	Box R-3	Box R-4	Box L-1	Box L-2	Box L-3	Box L-4	Total Mileage
1	OK	OK	1 lb.		OK	OK	OK		390
2									
3									
30									
31									

These records show the history of driving box conditions on each locomotive during the month

will be noted that locomotive No. 462 which was put in the shop on March 12, 1925, for Class 5 repairs, was scheduled out on March 29, 1925. By referring to the form shown in Fig. 2, it will be noticed that a cross has been marked under the twelfth day of the month which indicates that this engine entered the shop on that day. As previously stated, in the daily foremen's meeting, the schedule form shown in Fig. 1 is checked up each day, and providing all work which has been scheduled to be done on a certain locomotive has been completed on schedule time, a cross mark is entered on the progress form for that day. If any of the items on the schedule

Class 5 Repairs

Engine No. 462
Date in 3/12/25
Date out 3/29/25

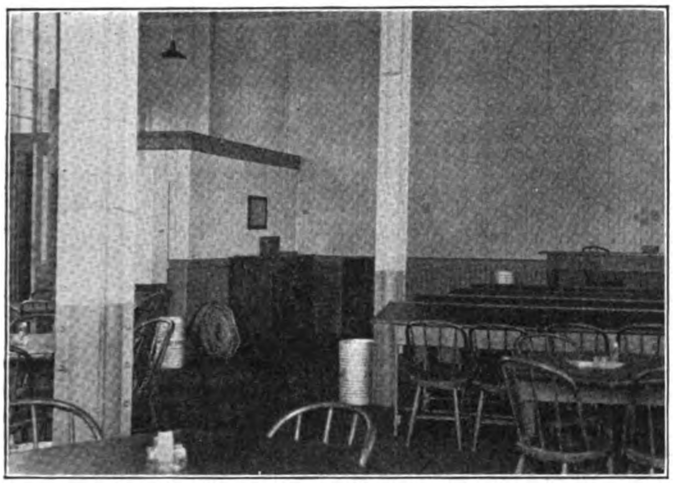
Date · Days	Engine-house	Boiler shop	Annex floor erecting	Smith shop	Machine shop	Rods and motion work	Stokers, pipe and special work	Carmen work	Tin shop
1	Placed in bes.	Inspected washed							
2		Flues removed							
3		Flues and bolts							
4		Test							
5			Wheels removed			Rods received			
6					Boxes received	Motion work received			
7			All parts delivered				Stoker parts delivered		Motion work
8			Hub size given						Cross-heads
9				Frame work	Motion work				
10				Spring rigging	Cross-heads	Valves and motion			
11			Valves and crossheads	Brake rigging					
12			Guides and pistons	Truck work					
13		Jacket lagging	Frame work		Wheels				
14			Shoes and wedges laid out					Cab	
15		All work	Spring work		Shoes and wedges	Rods	Pipe work	Sash	
16			Wheeled					Engine painted	
17	Engine coupled	Fired up							
18	Break in								
19									

Fig. 1—Form for indicating work to be performed by different departments on each day while locomotive is in the shop

form have not been completed on time the space for that particular date on the progress record is left blank.

It can be readily seen that if all work on all locomotives has been completed to date, there will be a cross in the daily column on the progress record for all locomotives remaining in the shop. By referring to Fig. 2, this can be seen under the column headed March 26. The first four lines of the progress record under the date of March 26 are blank because of the fact that these locomotives have previously left the shop on the dates indicated by the circles.

If for any reason the work on any particular locomotive is not up to schedule, the blank space opposite the number of that locomotive and under the current date on the progress report will constitute a break in the continuity of the vertical lines of crosses. Wherever a blank space appears on a progressive record for any day, it is a warning to the master mechanic that the work on that particular locomotive is behind schedule and he can immediately have an investigation to determine the cause.



The foremen's training classroom

Increased efficiency obtained

The inauguration of this plan of maintenance has resulted in increased efficiency in many ways. The feature of assigning locomotives to definite gangs has not only relieved the supervisors of a great amount of detail work, but it has served to definitely fix responsibility for all work. The average running repair gang working on serviceable freight and passenger power does not have more than seven to ten assigned locomotives to maintain, and, because of the fact that they are working on the same locomotives day after day, they are able to keep in close touch with the work required. Also, the road crews have come to know the men in the enginehouse who maintain the locomotives they handle and in this way a spirit of co-operation has been brought about which is being reflected in a higher standard of maintenance.

A concerted effort has been made to effect a reduction in terminal detentions. To this end a bulletin board was posted in the enginehouse on which every terminal detention is marked up, showing the engine number, the actual number of minutes delayed, the cause of delay and the *man responsible*. This practice has had its effect and, inasmuch as the terminal detention record may be considered a fair indicator of the over-all efficiency of the enginehouse organization, it is interesting to note the consistent reduction in terminal detentions, as shown by Table I, over a period of 15 months, and particularly since the present system went into effect in April, 1924.

Table I—Locomotives despatched and terminal detention at Sayre by months

	Locomotives despatched	Terminal detention hr.	Terminal detention min.	No. min. delay per 100 locos. despatched
January, 1924	3,740	15	45	25.2
February, 1924	3,509	11	50	20.2
March, 1924	3,611	29	38	49.4
April, 1924	3,387	25	35	47.0
May, 1924	3,696	10	15	17.1
June, 1924	3,322	13	0	23.5
July, 1924	3,337	6	45	12.2
August, 1924	3,537	9	35	16.3
September, 1924	3,644	6	30	10.7
October, 1924	4,013	9	47	14.7
November, 1924	3,737	8	33	19.1
December, 1924	3,471	6	5	10.5
January, 1925	3,283	6	50	12.5
February, 1925	3,246	8	38	15.9
March, 1925	3,308	3	50	6.9

Likewise, a marked improvement is evident in the matter of locomotive failures on the road. The average number of failures per month during the first six months of 1924 was 23 and the average number of locomotive-miles per failure was 18,788. During the last six months of 1924 the average number of failures per month had dropped to seven and the mileage per failure had increased to 56,181. In October, 1924, there were only six failures and the mileage was 69,624. These figures are averages for all classes of service. Incidentally, the reduction in the number of locomotive road failures has had a beneficial effect on the average car mileage per day.

Employee relations

Practically no effort has been spared on the part of the Lehigh Valley to improve the morale of all the employees. At the Sayre terminal, which is located adjacent to the large system shops, many novel features have been inaugurated to promote cordial relations. An assembly hall has been provided in which social functions take place and in connection with the assembly hall a cafeteria has been established for the convenience of the men. A man has been assigned from the organization at Sayre terminal who devotes his entire time to personnel work among the enginehouse employees.

The enginehouse mechanics are all employed on a

Lehigh Valley Railroad
Schedule and Progress of Locos. Through Enginehouse and Shops
Sayre Annex — Month of March
Seneca Division, Sayre, Pa.

Class Repairs	Engs. in shop	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
6	3263		X	X	X	X	X	X	X	X	X	X	X	0																		
5	2121				X	X	X	X	X	X	X	X	X	X	X	X	X	X	0													
5	448						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0								
5	2104								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0						
5	471										X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
5	482												X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
5	2100																	X	X	X	X	X	X	X	X	X	X					
5	446																			X	X	X	X	X	X	X	X					
5	452																								X	X	X					

Fig. 2—Form for recording the progress of locomotives through the shop

day-work basis and a service record is kept for each man. With the system of assigned repairs in effect, it is a comparatively easy matter to know the individual is performing his duties, and these records are carefully checked up periodically with the idea of properly rewarding meritorious service or administering discipline, should the occasion demand.

Another feature of the personnel work is the recent establishment of a foremen's training class. The entire supervisory force of the enginehouse and annex, consisting of 25 men, has enrolled in the correspondence engineering extension department of the Pennsylvania State College and are pursuing studies bearing on the important factors of employee relations and the principles of shop organization. A special room has been set aside for the use of the foremen's training class and it is gradually being equipped with all facilities required in a classroom of this description, including many charts and drawings used for instruction purposes as well as a library of important technical books and periodicals. The foremen's training class meets at least once a week and all are carrying on their studies in the extension course at the same rate of progress, class instruction rather than individual study constituting the program.

Conclusion

A study of operating conditions at the Sayre terminal after the organization had been in effect for a period of about 12 months disclosed the fact that it had been possible to effect a reduction of terminal operating expenses and at the same time increase the output. The assignment of locomotives and crews has made it possible to increase the number of turn-around runs, and locomotives are assigned as nearly as possible to trains for which they are particularly suited. It has also been possible to effect a decrease in road supervision and engine crew expense due to improved operation and maintenance. As a means of direct comparison, considering the first two months of 1925 and the same two months of 1924, the records show a reduction of 30 per cent in man-hours, 63 per cent in overtime, 27 per cent in payroll and 40 per cent in materials used. A reduction in force of approximately 110 men has been made possible by the re-organization. It might be added that most of these men have been absorbed by transfer to other departments or other points on the road and have not been released from service. For the above-mentioned period there has been an average total reduction of approximately 30 per cent in all the terminal operating expenses chargeable to the locomotive department.

Daily Consumption of Driving Box Grease
Sayre Enginehouse

Eng. No.	Box R-1	Box R-2	Box R-3	Box R-4	Box L-1	Box L-2	Box L-3	Box L-4	Total Mileage	
2092	OK	OK	1 lb.	OK	OK	OK	OK	OK	390	

Sayre, Pa. (Signed) ____________ Box Packer

____________ Date

Daily record of driving box conditions and grease consumption

One of the outstanding facts in connection with this terminal operation is that conditions are such that it is possible to keep ahead of the work at all times. As previously mentioned, eight locomotives are maintained ready for emergency service so that it is not necessary to despatch power on anticipated repairs.

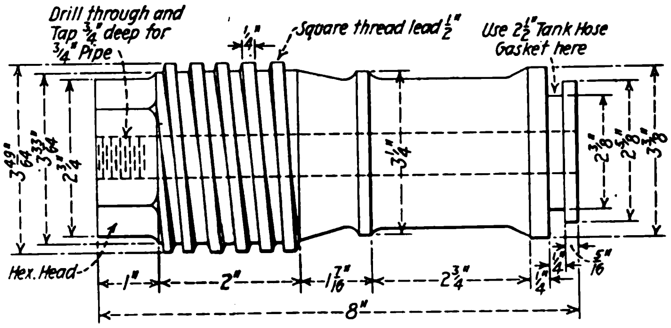
In considering the results of this operation, the fact must not be overlooked that the Lehigh Valley has made remarkable progress in establishing a spirit of co-operation among its employees. The new scheme of enginehouse organization did not meet with instant favor. After over a year of actual operation, however, it has demonstrated distinct advantages not only to the company but to the men, who are keenly enthusiastic over its possibilities.

Nozzle for testing feed-water heaters

By A. T. E.

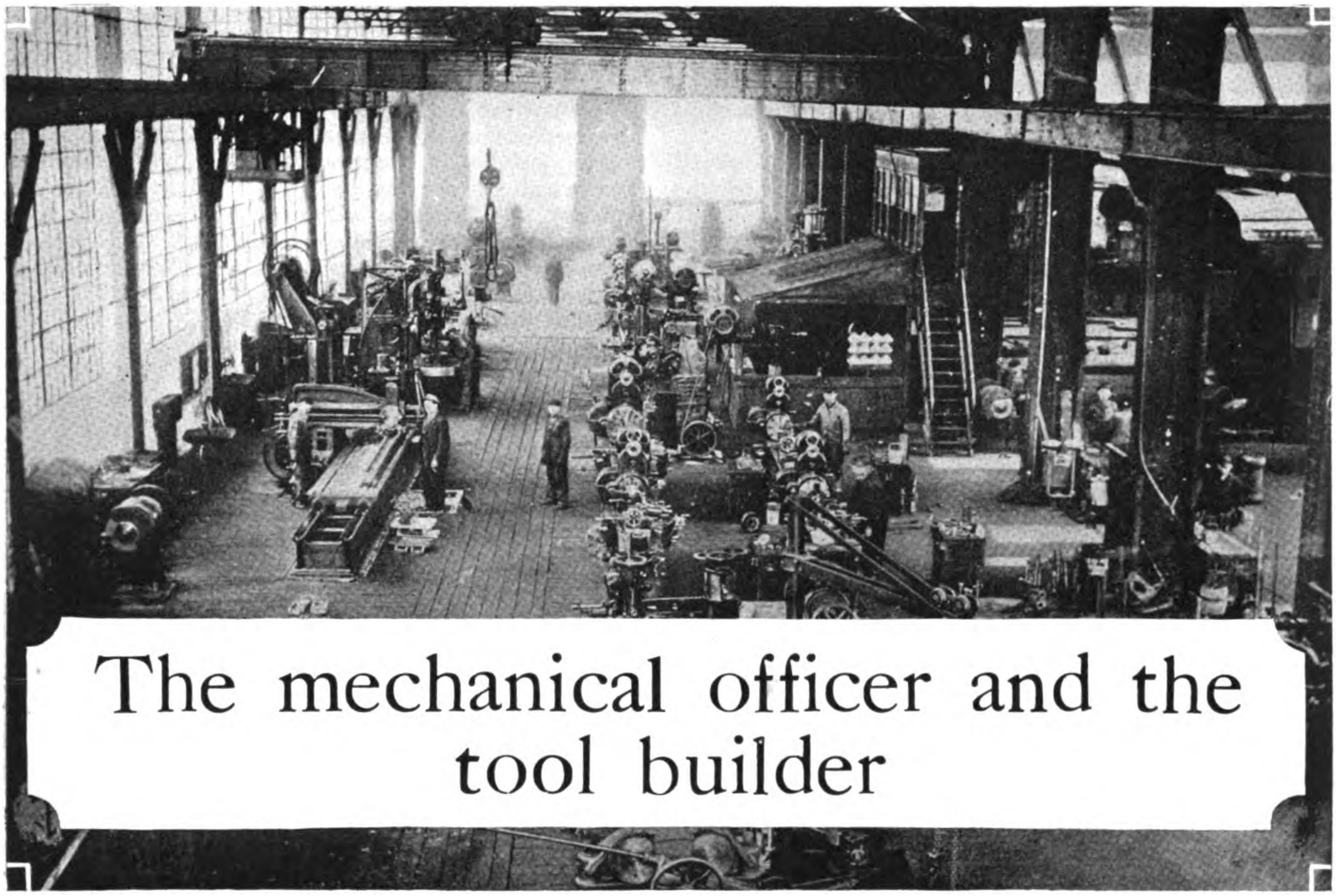
THE device shown in the sketch is used in testing locomotive feed-water heaters equipped with "Y" connections in the branch pipe for the purpose of washing out the feed-water heater. It has been the practice in recent years to equip feed-water heaters with these "Y" connections, particularly in territories having bad water. The fitting shown in the sketch may be used on either the condensate line where it returns to the tank, or on the feed-water pump supply pipe.

It is the usual practice to test the feed-water heater at the time of the monthly inspection of the locomotive. This is done by closing the locomotive boiler check stop valve and opening the condensate valve. Water is pumped into the feed-water heater under pressure through a tapped hole in the end of the heater, which is plugged when not in use, or through a tapped hole located just above the flanged connection to the branch pipe. Water coming out of the condensate valve at the front of the tank or under the cab, indicates a leak in the heater tubes. This procedure is also followed in cases where the heater has the condensate pipe returning to the feed-water pump supply line. In testing this type of equipment the locomotive tank valve is closed tight. Water from the condensate valve might indicate that there is a leak in the feed-water heater tubes or that water is passing by the feed-water pump valves and back through the supply pipe. However, if the fitting shown in the sketch is screwed into the connection of the branch pipe leading to the heater, water from the condensate valve will show that the leak is due to a bad feed-water heater tube.



Nozzle for testing feed-water heaters of the closed type

In cases where the equipment has the condensate pipe returning to the supply pipe of the feed-water pump, with no "Y" connection in the branch pipe, the heater can be tested by blanking the branch pipe leading to the pump or breaking a joint of the condensate pipe between the heater and the supply pipe.



The mechanical officer and the tool builder

Some possibilities for co-operation as seen from the viewpoint of the machine tool industry

By E. F. DuBrul
General Manager, National Machine Tool Builders Association, Cincinnati, Ohio

ALL business is necessarily a matter of co-operation. In small scale, localized business co-operation is between individual producers and users. As the business of the world expands, co-operation extends as between larger and larger economic units, and between greater and greater numbers of units. In time, numbers of independently acting units are gathered into various sorts of associations for the purpose of securing better co-operation. Through such associations the common problems of whole industries are co-operatively studied and solved. Such problems are not solely the internal problems of the industry, but also those that require attention in the mass because of contacts with other industries and interests.

Without such organizations to present the broad industry problem, whole industries suffer waste because their natural co-laborers are not informed of the possibilities of better co-operation. The railroads themselves have been conspicuous sufferers at the hands of the public because of failure to organize along broad lines of industry co-operation. Through co-operation between industry organizations the common problems of diverse industries are studied and solved to bring about still closer co-operation, and thereby to make still more effective the use of the man power of the world.

Through its association, the machine tool industry is continuously collecting, classifying, studying and distributing information and seeking to promote group co-operation with industries using machine tools. Some of the information coming to the association deals with conditions met in selling machine tools to railroads. Some of these conditions could well be modified, to the great benefit of the railroads themselves. The following remarks are not universally applicable to all roads, of course. But they do reflect conditions that are common enough to be of interest to the readers of *Railway Mechanical Engineer.*

Buying machine tool value, not price

Too many railroads buy machine tools on price as the main factor. Where definite specifications can be made, and goods checked against them, then price is a heavy factor. The lower price, all other conditions being equal, should command the business. But, in buying a machine tool one buys an individualized product. No two manufacturers build tools that are identical in structure. To decide sensibly as between two similar machines many things must be taken into consideration before one can really say that Tool *A* at its price is preferable to Tool *B* at its price. This determination is an engineering function. If a purchasing policy is established to the neglect of this engineering function, railroad's shop efficiency suffers to an extent that is of essential interest to the public that pays the bill.

It is to the common interest of the roads, the public and

the machine tool industry that railroad purchases of machine tools be made on the engineering basis, and not on the mere basis of price. Therefore, it is the duty of mechanical department officers, in co-operation with the organized machine tool industry, to devise scientific engineering methods of purchasing.

Some roads may have a really scientific basis of scoring or otherwise weighing the various factors on which the relative merits of similar machines are finally judged. If so, it would be to the benefit of all railroads to have such methods studied and standardized. If there are such definite methods of scoring they are in force on very few railroads. In most cases where the mechanical department has the actual power of decision, the decision is made by "general impression" rather than by definite scoring. The mechanical men "like" such and such a machine more than they do another similar one, but they seldom put the reasons for their likes and dislikes down on paper. In other words, they do not definitely analyze and "score" the machines one against the other. Naturally, when the purchasing or financial authorities want to know why they are asked to pay more for one machine than is asked for another, the mechanical officer is at a loss for an answer, if he has not gone at the matter in a cold blooded, engineering way.

I know it is not going to be easy to devise any scoring system. But I also know that unless and until it is devised, any road's mechanical department will buy on impressions rather than on classified facts that can be defended when the price looks too big to the purchasing department. It seems to me to be up to the railway mechanical department officers to devise good methods of applying engineering methods to railroad buying of machine tools and to call the organized machine tool industry's engineers into consultation on the problem.

Internal consultations and explanations

Reports frequently reach us that subordinates in railroad shops have asked for certain tools, but that the superior officers have given them something else—without explanation as to why the subordinate's request was not complied with. Now, while there are probably good reasons for the change, I submit that it is not good management to leave the subordinate in ignorance of those reasons. To be given something other than the tool he had recommended, without being told why his recommendation was not approved, is sure to cause him to lose interest and initiative, and to become a "buck-passer."

Use the machine tool builders' service

Many mechanical officers seem to lack appreciation of the value of the consulting service that many machine tool builders gladly place at the disposal of their customers. If they do not use this service, their shop management is less efficient than it should be.

Some mechanical officers seem to think that such offers of service are merely schemes for "putting something over" on the mechanical department. Now, any man with that idea is certainly not of the engineering type; he is not open minded to learn all the facts that will help him in running his own job. There is much criticism of the efficiency of railroad shops and much of this criticism is justified. It will harm any mechanical officer and his road if he closes his ears to this general criticism. To close his doors to able men who are desirous of helping him, is itself to say the least, a confession of incompetence. Machine tool engineers can show the shop supervisors many a good way of reducing costs of repairs by better tooling or handling of machine tools now in their shops. The only thing "put over" in such cases, is something to the direct benefit of the men served, because it makes them better railway men.

If the machine tool builder is willing to study a given job, and present definite data as to production and cost, any competent engineer can then determine whether the new methods would be profitable or not. There can be nothing sinister or suspicious in desiring to submit data from which a determination can be made as to a probable economy. On the other hand, there is something suspicious in a refusal to permit such submittal. It is perfectly natural to ask, "Why should a man refuse to consider such data unless he is trying to cover up something?" Is he so incompetent that he cannot judge of the facts such data might show? Or is he opposed to the presentation of facts for fear that they might damage him in the eyes of his superiors? Or are there other sinister reasons for his opposition?

The mechanical officer should, like Cæsar's wife, be above suspicion of any such reasons and therefore he cannot afford to reject service of great value, offered to him by machine tool builders. Nor should he neglect to use such data when received.

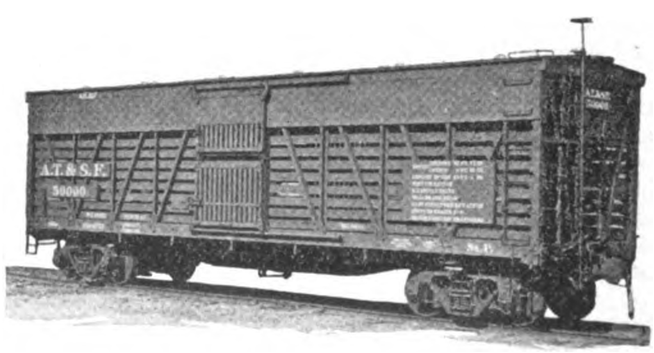
In offering such service the machine tool builder realizes that his own profit must come in making tools that are profit making investments for their users. He has to sell the profitableness of the tool to a competent buyer as the first step in selling the tool. Unless he can demonstrate "Profit" he cannot sell the tool. When he does demonstrate "Profit," the buyer purchases the tool merely as an incidental means for securing the "Profit." The competent builder and seller of machine tools is prepared to demonstrate "Profit" in a scientific impersonal engineering report wherever he can find "Profit" to exist for the user. Any mechanical officer who asks for this demonstration has done full duty by himself, his profession, his company and the public.

A duty to the public

The railroad business is one charged with a peculiar public interest, as we all know. That public interest demands that railway operation and management shall be efficient in every department so that the public shall pay the lowest rates for service consistent with the principle of a fair return on the railroads' property value. So it is the duty of the railway mechanical departments to use all available means to reduce the costs of maintaining the equipment entrusted to their care. The two things herein suggested will play some part in this reduction of maintenance costs. They are:

1. Devise and use definite scientific, engineering methods in purchasing machine tools.

2. Make free use of the production engineering service offered by machine tool builders to improve shop methods.



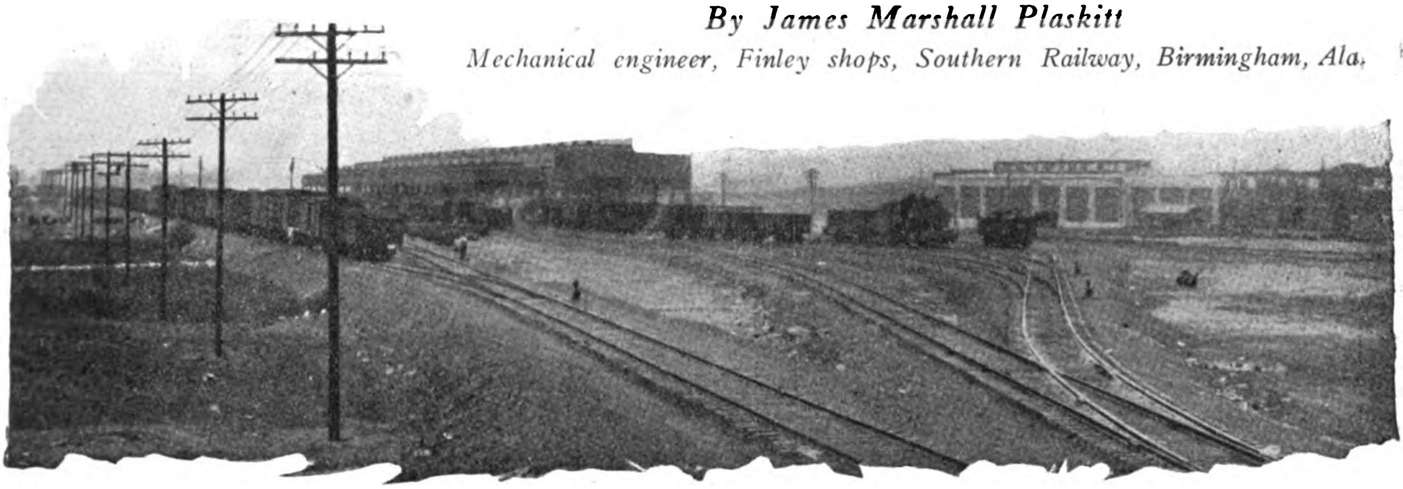
40-Ton, steel-frame, single-deck stock and coke car built by the Standard Steel Car Company

A modern freight car repair shop

Southern completes plant at Finley—New equipment helps to increase production.

By James Marshall Plaskitt

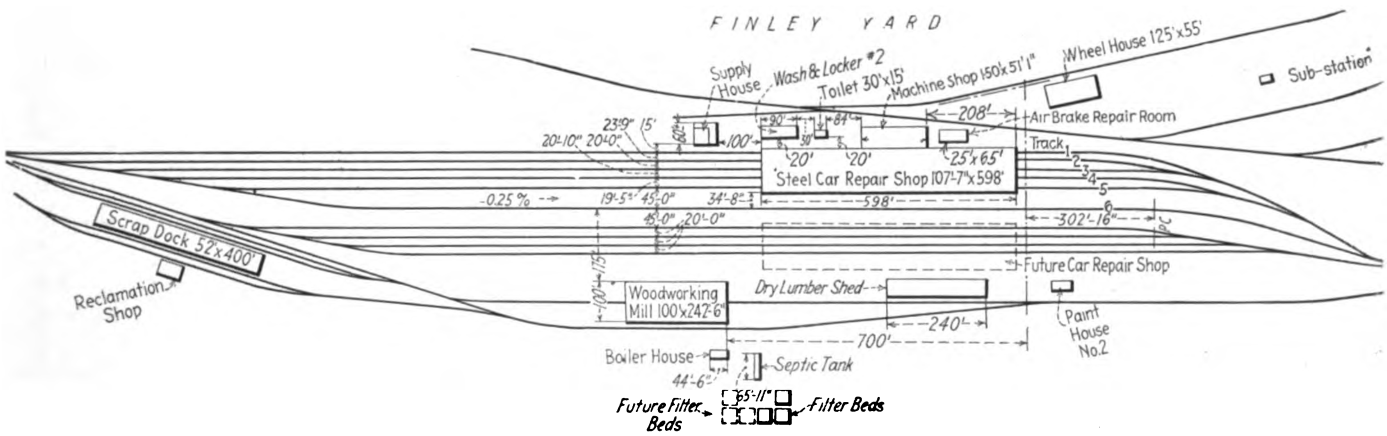
Mechanical engineer, Finley shops, Southern Railway, Birmingham, Ala.



On December 1, 1924, the freight car repair shops of the Southern Railway System were moved from Avondale, near Birmingham, Ala., to the new Finley shops at North Birmingham. The installation at Finley consists of both a car and locomotive repair shop, and also a 25-stall enginehouse which has been in operation for a number of years. The entire plant, the locomotive unit of which was described in the March, 1925, issue of the *Railway Mechanical Engineer,* is under the direct supervision of the master mechanic, to whom the general foreman of car repairs reports.

Practically the same scheme of administration as used for the locomotive shops is used in the management of the car shops. The master mechanic presides over joint meetings of the foremen in the car and locomotive departments. At these meetings policies to be established that affect the plant as a whole are outlined and discussed, errors and misunderstandings relative to handling the work are corrected and various suggestions for improving production are talked over. Weekly meetings are also held by the general foreman of car repairs with all the car department supervisors at which the program of performing the work is discussed, constructive suggestions and criticisms are received and the work is outlined for the coming week.

Daily progress reports are sent to the master mechanic each morning by the general foreman of car repairs. These reports contain a summary of the progress of the previous day's work in the entire Birmingham territory and they show the bad order cars awaiting repairs at all stations, the bad order cars repaired the previous day, cars painted the previous day, cars recommended for retirement or reconstruction, and the total number of men engaged in repairing cars. Similar figures are also compiled for foreign cars and included in the totals. In addition, the master mechanic keeps in personal touch with the progress of the work through frequent daily inspections.



Layout of the car repair tracks and buildings

The various department heads and their assistants are held rigidly responsible for the work under their supervision. The frequent staff meetings serve to clear up matters of doubt and also acquaint the foremen with the various developments in their particular fields.

It is evident, from what has been accomplished during the short period of time these shops have been in operation, that it was a wise step to abolish the use of antiquated

equipment in favor of more modern types, even though it required a large capital expenditure. A large repair point in the Birmingham territory is necessary for the Southern Railway System. Approximately 3,000 freight cars are handled in its terminals daily and this territory embodies one of the largest interchange points in the South. Interchange is made with the Birmingham Belt, the Atlanta, Birmingham & Atlantic, the St. Louis-San Francisco, the Birmingham Southern, the Central of Georgia, the Seaboard Air Line, the Illinois Central and the Louisville & Nashville.

Design and location of buildings facilitates production

The Finley shops occupy a tract of about 100 acres, the locomotive and car repair units being separated by sufficient ground to permit expansion should future requirements demand it. Referring to the cross-section drawing, the car repair shop is an open type shed built of structural steel and rests on a concrete foundation. It is 598 ft. long by 107 ft. 7 in. wide and is built with three bays containing five longitudinal tracks. Track No. 1 is served by two overhead electric cranes of 15-ton capacity. Tracks No. 2 and No. 3 are served by cranes of the same type but of 20-ton capacity. These three tracks are used for heavy overhauling or general repair work while tracks No. 4 and No. 5 are used for finishing, such as completing the carpenter and light metal work on box cars. Permanent scaffolding, secured to the roof girders as shown in one of the illustrations, is located along tracks No. 4 and No. 5. It is hung so that the floor of the scaffolding is located at a height about half way up the side of the average box car body.

Table I—Machinery installed in the fabricating shop

No. of machines	Description
3	Acme double-head bolt cutters
1	36-in. Niles-Bement-Pond vertical drill press
1	5-ft. Dresses Machine Tool Co. radial drill
1	8-in. by 48-in. grindstone
1	Single head pipe threading machine
1	Cleveland Punch & Shear Works punch
1	Cleveland Punch & Shear Works shear
1	10-in. Southern railway pneumatic flanging clamp
1	500-lb. Bradley hammer
1	Buffalo Forge Co. blower
1	Southern railway pneumatic coupler yoke riveter
1	8-ft. Southern railway open forge
1	60-in. Southern railway open fire

Referring to the layout drawing of the car shops, it will be noted that the machine shop is a part of the car repair shop building, conveniently located midway along the No. 1 track side. It is 158 ft. long by 51 ft. wide and opens directly into the car repair shed. This arrangement permits efficient handling of material from the machine shop to tracks No. 1, No. 2 and No. 3, where the general repair work on all-steel cars is performed. Considerable attention has been given to providing suitable and adequate machine tools, a list of which is shown in Table I.

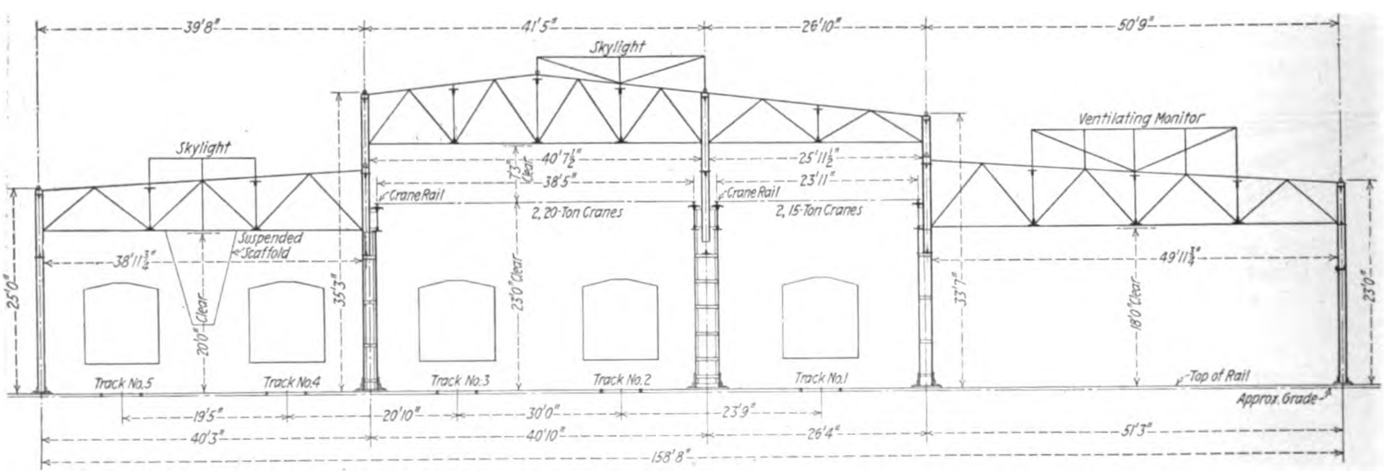
The entire building, including the machine shop, is well lighted. Steel sash skylights in the roof of the car repair shed and standard steel sash windows in the walls, provide excellent lighting conditions during the day. Pyle-National 1,000-watt flood lights are placed at the ends of the car repair shop, as shown in one of the illustrations, to provide light for the yard tracks in both directions leading away from the shed. Drop lights are placed at regular intervals within the building. These lights afford sufficient light for a full force at times when the work demands a night shift. Air manifolds and electric drops to serve the pneumatic and electric tools are located at the columns.

Permanent scaffolds on tracks No. 4 and No. 5

Wheel shop is well equipped

The wheel shop is of brick and concrete construction, 125 ft. long by 55 ft. 10 in. wide and is located northeast of the steel car repair shop. The floor is made of creosoted wooden blocks laid on a concrete base. The building is heated by a system of individual units which utilizes the exhaust steam from the power plant. Unit heaters are placed along the walls and along the interior lines of columns of the various shop buildings.

This shop is well equipped with machine tools, as shown in Table II, for the efficient handling of wheels and axles. The track located to the north of the building is used for

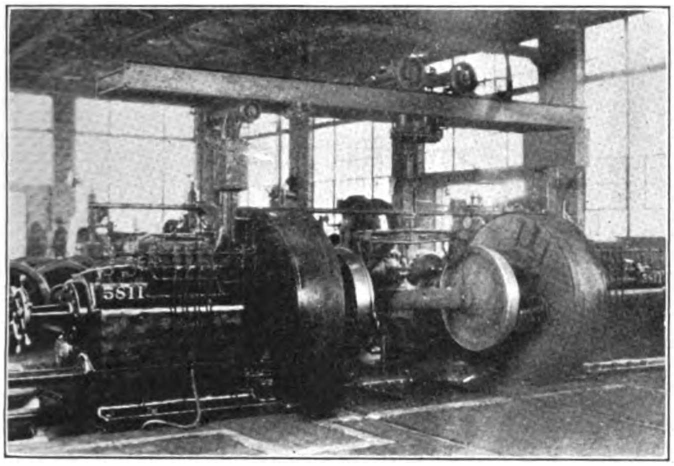


Cross section of the car repair shed

the transportation of wheels to the repair tracks. This track also serves the main and auxiliary storehouses.

The wood working mill

The wood working mill is a large, modern, steel frame and brick concrete structure, measuring 100 ft. by 242 ft. The floor is of wood block laid on concrete and is free from columns, steel trusses of 100 ft. span being used for the roof structure. The side and end walls are almost entirely of steel sash which, in addition to a large monitor has insured ample natural light. A track has been laid along the longitudinal center line with connections at each end to the car repair yard tracks. Some of the wood working equipment was transferred from the old shop at Avondale; however, a large part of the machines are new. A list of the machine tools installed in the wood mill is shown in Table III.



Turning steel wheels in the wheel shop

The arrangement of machine tools and equipment in the wood mill has been carefully planned so as to avoid any back-tracking or re-handling as material is routed through the shop. It is possible to handle all lumber from the dock at one end and route it directly through the mill to the opposite end for delivery to the lumber shed, which is shown in an illustration on page 340.

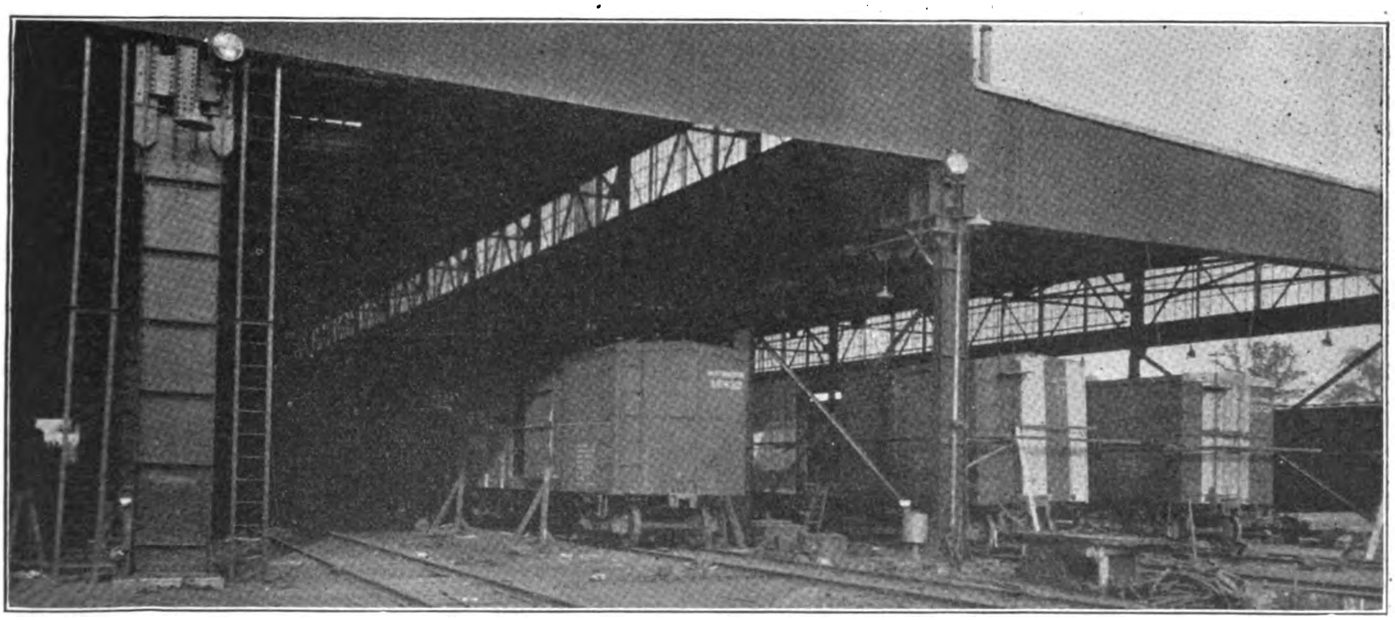
In the manufacture of side sills, the lumber is passed through an opening in the end wall of the mill from the dock directly to the four-side timber dresser or planer. It is next routed to the cut-off saw, layout benches, and thence to the two-spindle boring machine, where it is bored. Upon completion of this operation, it is routed to the tenoning machine, after which it is loaded and sent to the car repair shop. Practically the same route is followed in the case of end sills, except they are sent to the gainer after leaving the layout benches and from there to the combination hollow spindle mortiser.

Table II—Machine tools installed in the wheel shop

No. of machines	Description
1	48-in. Putnam boring mill
1	48-in. Niles-Bement-Pond car wheel boring mill
1	26-in. by 14-ft. Niles-Bement-Pond axle lathe
1	Safety Emery Wheel Co. emery wheel grinder, motor drive
1	300-ton Niles-Bement-Pond car wheel press
1	52-in. Niles-Bement-Pond heavy duty coach wheel lathe
1	200-ton Niles-Bement-Pond wheel press

Side doors are assembled at the east end of the mill where a steel-top table is located. The machines used in this work are arranged in close proximity to the table on which the doors are assembled and the nails are automatically clinched on the steel top as they are driven. The bottom iron structure or side door bottom guide, made from scrap flues in the blacksmith shop, are also applied here. Bearings 1¾ in. thick are left on the side door bottom guide strips by the blacksmith shop. These bearings function as wedges for the car door so that a tight fit is insured when the door is closed. The utilization of scrap flues for this purpose is a considerable saving.

A conveying system for removing shavings is now being installed. It is to be so arranged that it will collect the shavings at the various machines as fast as they accumulate. All shavings and wood waste material are used for fuel at the auxiliary power house which is located at the southeastern end of the wood mill, as shown in the layout drawing of the car repair tracks and buildings.



Exterior view of the car repair shed showing the location of the flood lights—Track No. 5 at the extreme right

The dry lumber shed is located east of the wood working mill as shown in the layout drawing of the car repair tracks and buildings. It is of heavy timber construction, boarded at the ends and measures 41 ft. by 241 ft., thus

providing ample storage space. Its location makes it readily accessible for the delivery of material to the wood mill or the car repair shop as well as for the reception of lumber shipments.

Storage and delivery of material

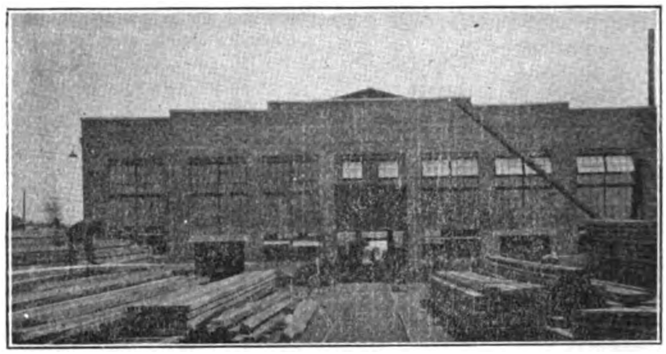
The main storehouse and office building is located adjacent to the locomotive unit. One end of this building, which was described in the March, 1925, *Railway Mechanical Engineer*, is devoted to the offices of the master mechanic, division storekeeper and the other to the store room. The administration of the stores department for both the car and locomotive departments is handled from this office. A sub-storehouse or supply house is located northwest of the car repair shop. This building was formerly used at the Finley enginehouse and was moved to its present location when the new car shops were constructed. It is of frame construction. The system used for storing material is similar to the one used in the main storehouse. Casting docks are provided west of the building and delivery of the material from the sub-storehouse and casting yard to the car repair shop is handled by means of Ford tractors and trailers. The same system of delivery is used for handling lumber from the dry lumber shed to the wood working mill as well as for the delivery of all material to the crews working in the car repair shop. Special attention is given to the handling of supplies to see that they operate efficiently and that material is always at hand when needed.

Table III—Machine tools installed in the wood mill

No. of machines	Description
1	Berry & Orton band saw
1	Atlantic Works swinging cut-off saw
1	Atlantic filing and setting bench
1	Milwaukee Sander Co. knife grinder
1	Manning, Maxwell & Moore saw gunning machine
1	Fay & Egan combination band resaw
1	Fay & Egan surface sander
1	Berry & Orton sill tenoning machine
1	Fay & Egan mortiser and boring machine
1	Fay & Egan car gainer
1	Fay & Egan three-spindle boring machine
1	Fay & Egan rip saw
1	L. Power & Co. pony planer
1	Double spindle shaper
1	Small single-head sash and blind tenoning machine
1	33-in. by 60-in. rip saw
1	Berry & Orton railway cut-off saw
2	Fay & Egan planers
1	Singer sewing machine for upholstery work
1	No. 10 S. A. Woods Machine Co. large planer

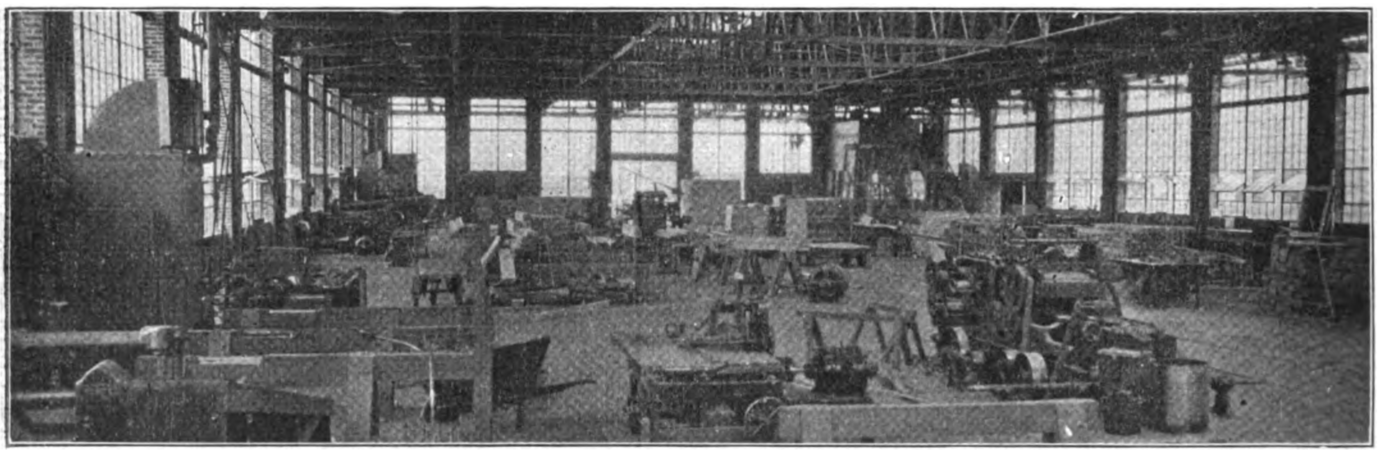
Complete facilities are provided for painting

The paint shop is located immediately east of the dry lumber shed and alongside of the same track. The building is of brick and concrete construction and contains two rooms separated by fireproof doors. One room contains the tanks for paint mixing oils and paint storage, while the other room is used for stencil racks, car painting records and a screen drying rack, and is equipped with work benches and easels for sign painting and special jobs. As shown in one of the illustrations, the stencil racks consist of several panels or doors hinged at the back which may be swung open or closed as desired. An entire set of stencils for each class of freight cars is hung on a side of each of the panels. The idea is much the same as the picture files seen in many art galleries and the racks provide a unique and convenient method for keeping the stencils filed. A blackboard record is kept of the individual cars that are painted and stencilled so that all work may be credited properly to the material and labor charges.



View of the lumber docks and the west end of the wood mill

This paint shop is operated as an auxiliary to the main paint shop which is located in the locomotive unit. Practically all of the painting is performed mechanically, the cars being switched from the outgoing tracks of the car repair shop to the tracks east of the car repair shop. After the work of painting and stenciling has been completed, the cars are weighed, inspected and switched out at the west end of the car repair yard to be placed in service.



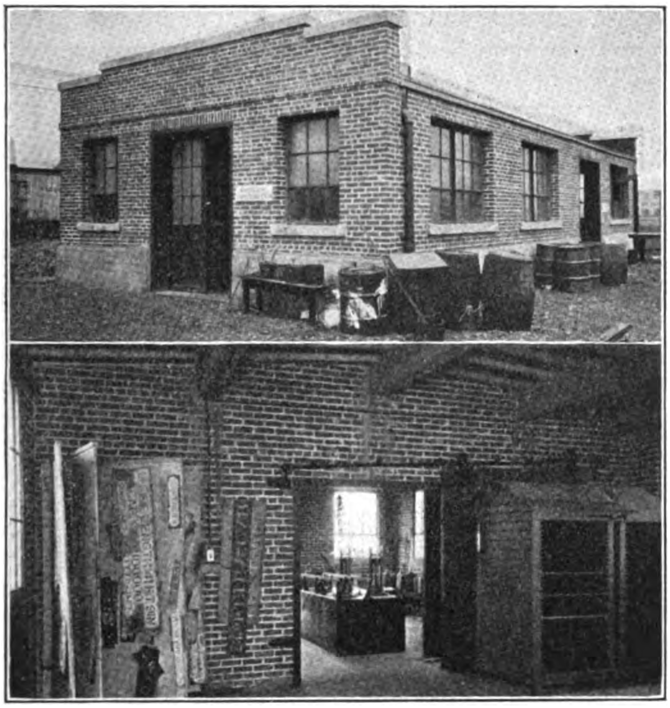
Interior view of the wood working mill

Method of handling repairs through the shop—Steel underframe box cars

At the present time the management has appropriated funds for the application of 80 steel underframes per month to box cars at the Finley shops. These appropriations are based on a certain fixed amount inclusive of labor and material for each car and the shop is not permitted to exceed a certain specified amount for the performance

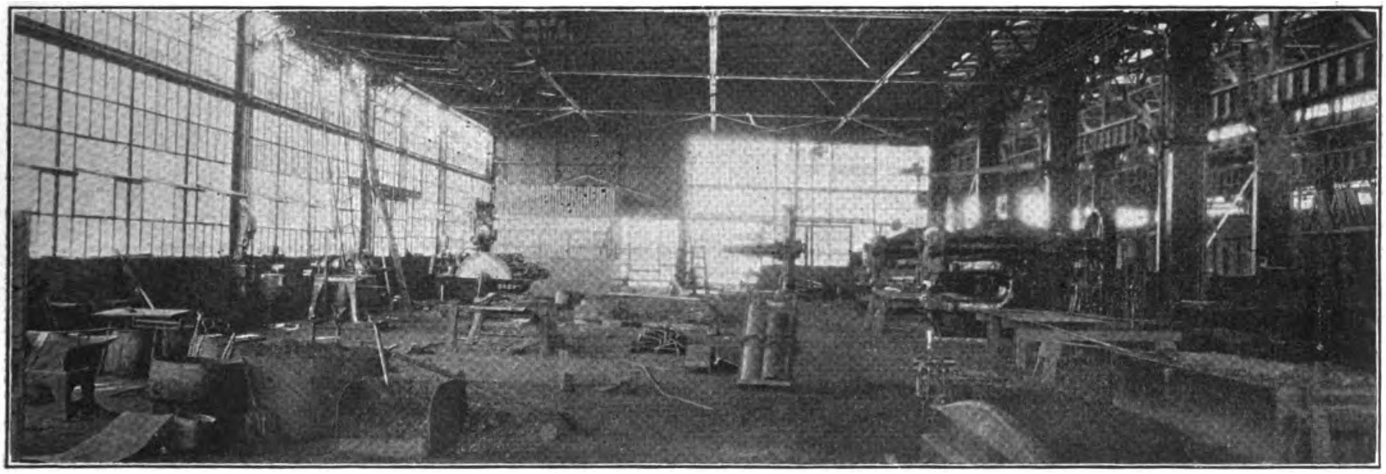
of this work. In addition to the work of installing steel underframes, there is a considerable amount of heavy repair work to perform on steel and other freight cars, such as the conversion of beer and ice cars to box cars and the overhauling of coaches.

Light and running repairs are handled on the five tracks



Above—Exterior view of the paint shop; Below—Interior view of the work room showing the stencil racks at the left

adjacent to the car repair shop. They have a combined capacity of approximately 200 cars. In addition, the repair tracks west of the car repair shop, having a capacity of 100 cars, can also be used for this work. The light repair tracks are usually "worked out" once a day. Provisions have been made for performing a certain



Interior view of the steel fabricating shop

amount of light repair work in the Finley yards and at the Thirty-Sixth street yards at Birmingham and also at 10 car repair points located at various stations throughout the Birmingham territory. Reports are forwarded by the car repair men at the various repair points throughout this territory to the office of the general foreman of car repairs at Finley. His office is located near the wood working mill and three billing repair clerks are employed to check the records and complete the billing repair cards for foreign lines in accordance with the American Railway Association interchange rules.

Applying steel underframes

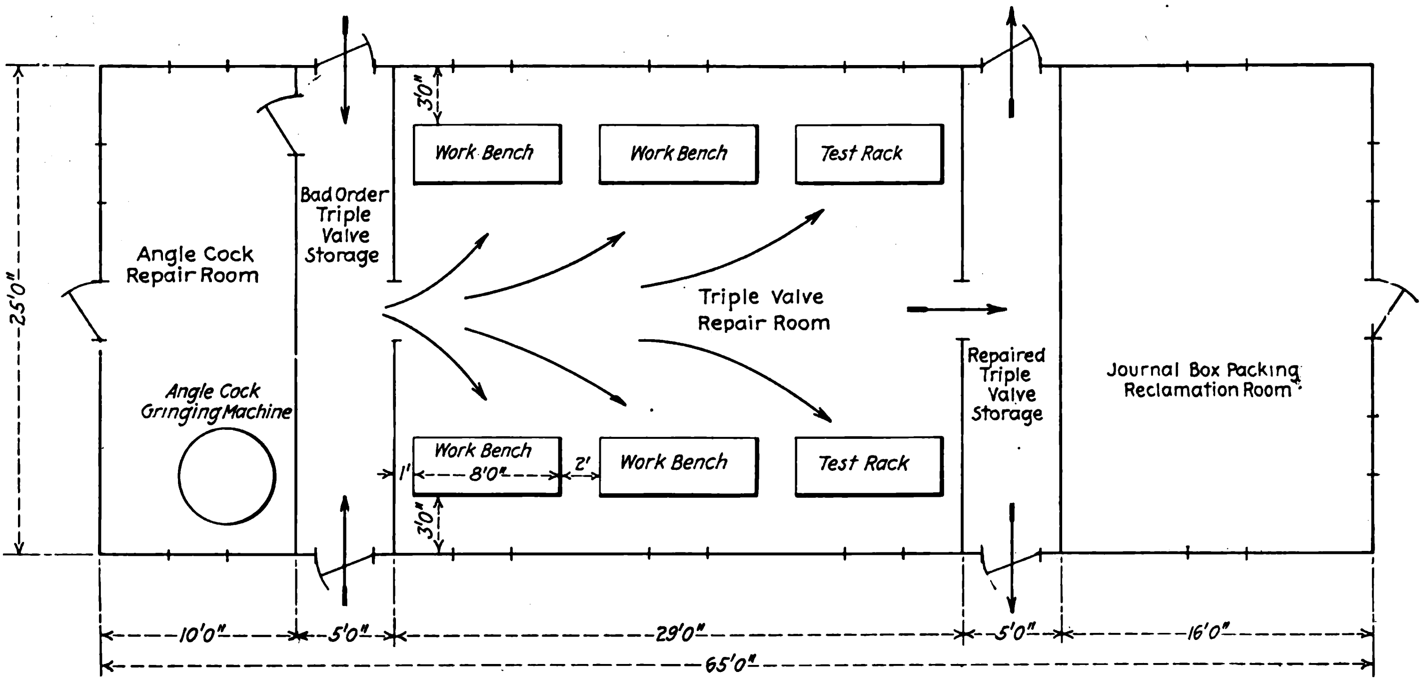
Bad ordered cars suitable for the application of steel underframes are switched to the car department as required. All work is performed with a view to restoring 100 per cent mileage to the cars. For this reason, it is necessary to make all of the required body repairs, repairs to the safety appliances, air brakes, foundation brake gear, trucks, etc., before the car leaves the shop. The work of stripping the decayed or otherwise defective material is performed as far as possible on the stripping tracks outside of the car repair shop. The amount of work necessary varies according to the actual condition of the car. After stripping, cuts of 12 cars are placed on tracks No. 2 or No. 3 or both, as deemed advisable. It is the usual practice to assign two men from the body and truck crews respectively to each car.

One of the illustrations shows the various operations performed on an individual box car receiving a steel underframe. This work is usually handled in the following manner. The body is lifted clear of the trucks by means of two 20-ton overhead cranes, each of which is provided with a steel cable sling. The trucks are then run forward just clear of the body and are spaced at the correct distance to receive the steel underframe. The car body is then lowered on two trestles and the body crew releases the cranes and proceeds with the work of repair. As soon as the cranes are released from the body, they are used to lift the steel underframe from storage and carry it to position over the trucks. The underframe is then lowered and placed on the trucks, the center pins are applied and secured. The next operation is applying the nailing sills to the steel underframe. As soon as this work is completed, the car body is then lifted clear of the trestles, moved forward and lowered in position on the steel underframe. Mention should be made of the fact that the underframe is not applied to the trucks until the truck crew has completed the work of repairs on the trucks.

After the body has been lowered in position on the steel underframe, it is fitted with down rods and secured to the underframe. When the entire truck is fitted with underframes, it is shifted to track No. 4 or No. 5, the crews following through for the finishing work, and the body repairs are then completed. The sequence of operations for body repairs is shown on page 339.

All repair work is performed as far as possible in the car repair shop. As soon as a cut of cars has been com-

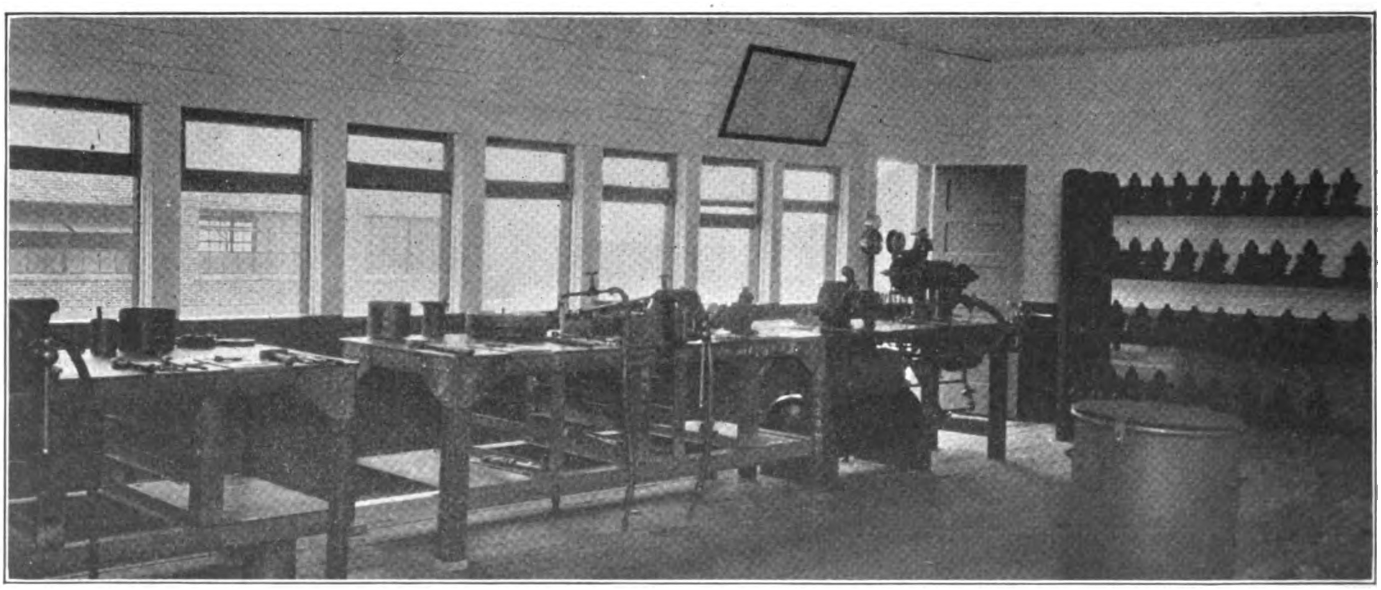
pleted, they are switched to one of the paint tracks at the east end of the shed adjacent to the paint shop. Here the cars are given two coats of paint by the mechanical process and are then moved to track No. 6, where the cars are stenciled. After a thorough inspection, the cut is marked O.K. for service and is then switched to the Finley transportation yard where the cars are weighed and placed in service. In the case of heavy repairs, where steel underframes are not applied, the operations are practically the same as far as the routing and methods of crane service are concerned. On account of having the service of the two overhead cranes for tracks No. 2 and No. 3, it was found impossible to install a permanent scaffolding, as was done for the finishing tracks No. 4 and No. 5. However, temporary scaffolds are erected and nailed to the car bodies. The loss of time in preparing this temporary arrangement does not materially decrease the efficiency of the work on these tracks. It is believed that this decrease will be eliminated by the utilization of sling scaffolding.



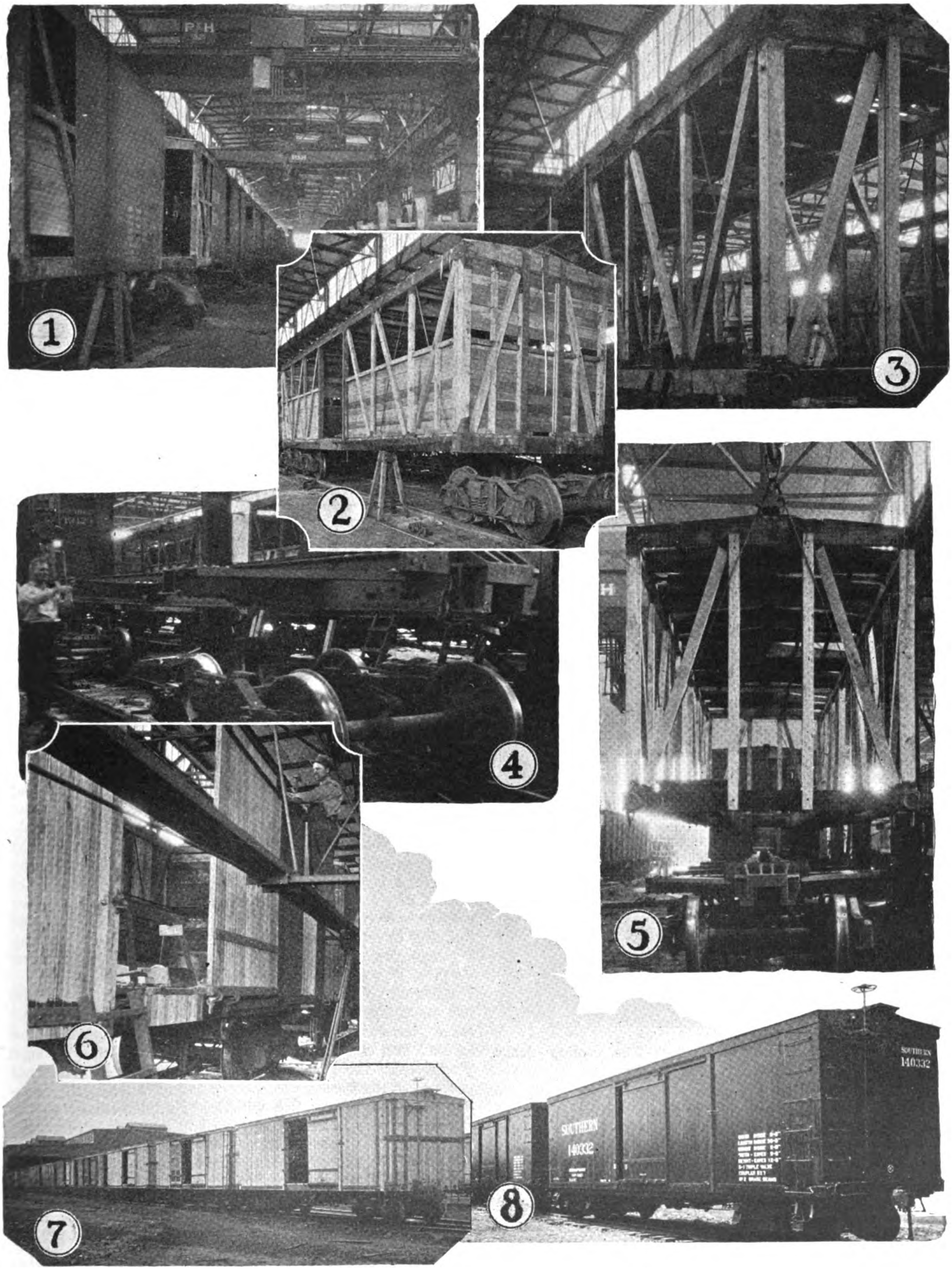
Floor plan of the air brake repair room—The arrows show the routing of the work through the shop

Heavy repairs to all-steel cars

Steel cars requiring general overhauling are placed on track No. 1 in the car repair shop. Little, if any, stripping is done before the cars are switched into the shed, as in the case of wooden freight cars, because of the ease with which the cranes can assist in this work. The various operations used in making repairs to steel cars may be summerized as follows: After the cars are switched to track No. 1, the stripping is accomplished with the assistance of the two cranes. Damaged and corroded parts are removed by the acetylene cutting torch when necessary. Steel parts, such as truck sides, bolsters, draft gears, brake beams and hangers are reclaimed by welding or are sent to the machine shop bay nearby for renewal or repairs as may be deemed necessary. All air



Interior view of the air brake repair room



Sequence of operations performed on a box car receiving a steel underframe

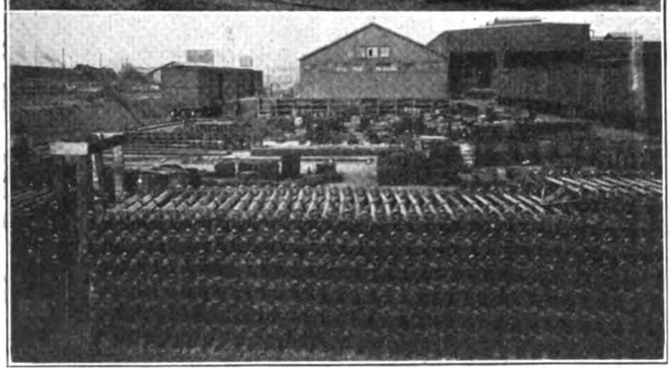
Fig. 1—After preliminary stripping; Fig. 2—Siding removed and trucks being run forward; Fig. 3—Body ready for repairs; Fig. 4—Lowering underframe onto the trucks; Fig. 5—Lowering body onto the underframe; Fig. 6—Applying the siding; Fig. 7—Repair work completed; Fig. 8—Painted and ready for service.

brake and piping work, including that of box and other freight cars, is classified and performed strictly in accordance with A. R. A. requirements. Truck repairs are performed by special gangs. A body gang usually consists of two car repair men and helpers, who remove or apply all the necessary steel to the body. After the work of repair has been completed, the cars are then switched in cuts to the paint tracks. The work of painting, stenciling and weighing is performed in practically the same manner as for the box cars.

System for handling air brake repairs for the car shop

A feature of the car repair work at Finley is the air brake repair department which is located north of the car repair shop adjacent to the machine shop. The building is constructed entirely of scrap beams, sills, siding and planking that has been removed from old cars. The cost of construction was, therefore, quite low. The windows were taken from an old coach. Referring to the floor plan of the air brake room, the building is 25 ft. wide by 65 ft. long. It is divided into three rooms, the first of which is used for the reclamation and grinding of angle cocks. The center room, which is the largest, is used as the triple valve repair and test room. The third room is used for the reclamation of journal box packing and is not connected with the air brake department.

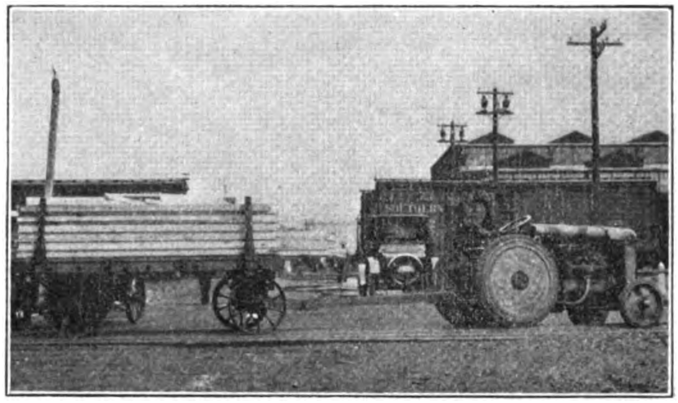
The triple valve repair and test room contains four work benches and two test racks. Bad order triple valves are brought into the room and placed on a storage rack which is located along the wall next to the angle cock repair room. The routing of the triple valves through the repair room is shown by the arrows. Upon completion of the



Above—The dry lumber shed—Below—The casting docks west of the sub-storehouse

work of repairing and testing, the triple valves are placed in a second storage rack at the opposite end of the room, from which valves can be removed as needed. The work benches are of steel, manufactured in the boiler shop, and are of a construction similar to those used in the air brake department of the locomotive unit. The angle cock repair room has two entrances, one of which leads into the triple valve repair room and the other is an outside entrance located at the end of the building. Bad order angle cocks may be routed through the same entrance as that used for bad order triple valves, and directly into the air brake repair room. Repaired angle cocks are routed through the outside entrance without any interference with the work. A multiple angle cock grinding machine is used for grinding angle cocks, located as shown in the floor plan.

Considerable attention is paid to the work of air brake repairs. The general air brake foreman presides over meetings of the staff, at which information and instruction relative to air brake maintenance is given. The proper methods to be employed as well as the recording of the various operations of the Rules of Interchange are discussed at these meetings. Weekly classes of instruction are also held in order to better acquaint the men with the correct methods employed in the repair and maintenance of air brakes.



Material is handled by trailers and Ford tractors

The journal box packing reclamation room is equipped entirely with shop-built machines and vats for the work of reclamation. It has a concrete floor and is provided with suitable connections for steam which is used in the process of reclamation.

Excellent comfort facilities are provided for the workmen

A wash and locker room is located in a separate building of brick and concrete construction, convenient to the car repair shop. The locker room is arranged with double rows of high steel lockers and ample space is provided at the opposite end where washing facilities for the men have been installed. A convenient feature of the lockers is that they have been built high enough to hang suits or overcoats in them without having to be folded. A separate building for the toilets is located approximately midway between the wash and locker building and the machine shop.

Adequate facilities have also been provided for protection against fire. A number of hose reel carts have been placed in small buildings of wooden construction located in a convenient position to the fire plugs. A sign placed over the door of each hose house gives instructions as to the location of the fire as indicated by the number of blasts of the fire whistle. Supplementary to the fire fighting equipment is an excellent departmental organization. Weekly fire drills are held at unexpected periods and at one of these tests recently conducted three streams were turned on the tank shop of the locomotive unit in 1 min. 30 sec. after the alarm had been given.

Administration

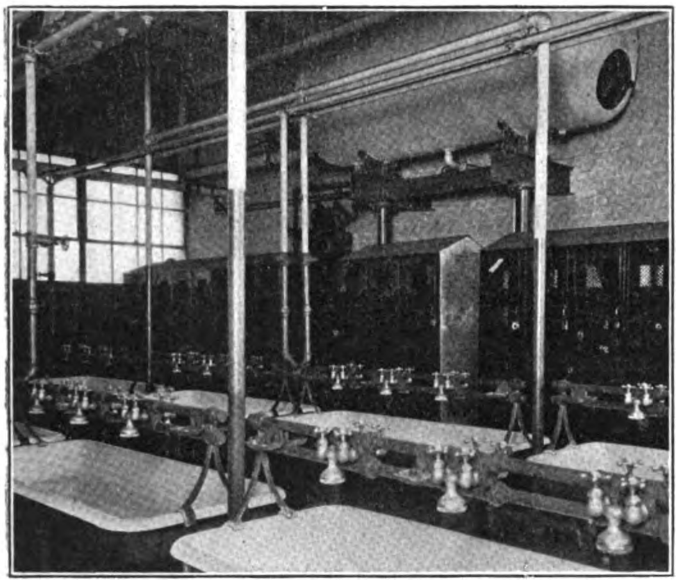
It is a policy of the administration to keep a close watch on expenditures. The system in vogue is based on the amount expended for labor and material for all repair work performed. In issuing authority for addition and

betterment work, such as the application of steel underframes or the conversion of cars from one type to another, a separate appropriation is assigned and an accurate record is kept of the labor and material expended on each individual car. All requisitions for material must show the station at which the work is being done, the number of the car and to what appropriation the amount expended should be charged. In addition to this material record, a labor record is kept by charging the workman's time against each individual car. Credit is allowed for all material scrapped and deductions are made for all scrap and second-hand material.

All the general work is charged to foreign and system car accounts as required by maintenance of equipment department instructions. A careful check is kept in the master mechanic's office as to the progress and cost of repairs from these sources. By means of this check the possibility of exceeding the appropriation is practically eliminated.

Co-operation between the men and supervisory forces has been an important factor

As stated in a preceding paragraph the results that have already been obtained during the short period of operation



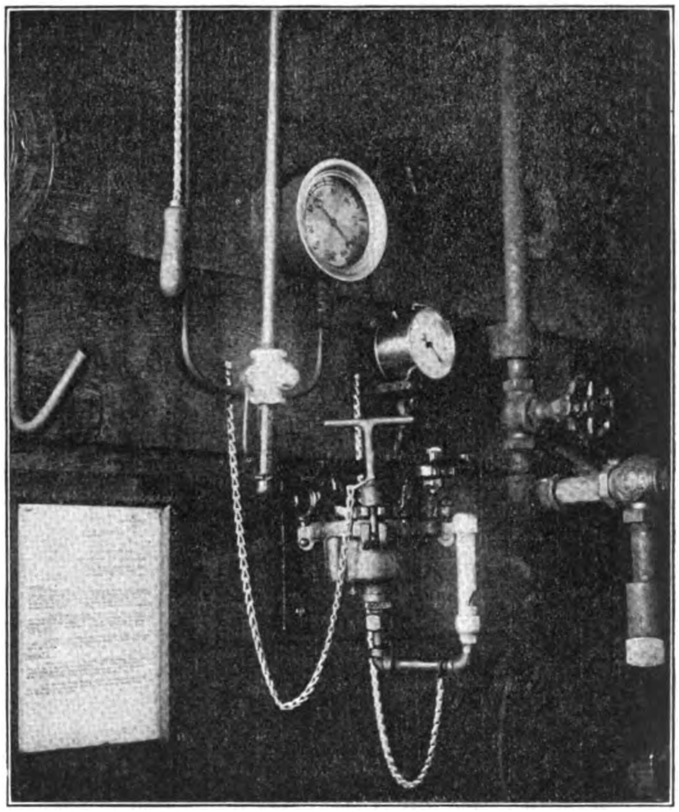
Interior of the wash and locker room—The lockers can accommodate overcoats or suits without folding

of the Finley car shops show a considerable decrease in the cost of production over that of the old shops at Avondale. No small share of the credit can be given to the spirit of co-operation and interest that has been shown by the men and the supervisory forces in bringing about the record that has already been achieved. C. E. Keever, master mechanic of the Finley shops, has created an excellent spirit of co-operation and progressiveness in both the car and locomotive departments. The shops were laid out under the general direction of H. W. Miller, vice-president, the engineering details being handled by B. Herman, chief engineer. The machine tool and mechanical department details were planned under the direction of R. L. Ettenger, mechanical assistant to the vice-president. The development of the plans and construction for the car shops as well as the locomotive shops, described on page 165 of the March issue of the *Railway Mechanical Engineer* were carried forward by Dwight P. Robinson & Co., Inc., New York.

A convenient whistle valve test rack

By Frank Bentley

THE accompanying illustration shows a conveniently arranged whistle valve test rack. Above the rack, but not shown in the illustration, is the drum for the air volume, out of one end of which leads the pipe carrying the necessary car discharge valve with the restricted orifice. The chain to the discharge valve, which is shown at the left, is pulleyed so that the handle attached to it may be pulled while watching the timing clock to the right. The testing whistle and the wrench for removing the diaphragm case under examination are never lost or misplaced as they are kept at the rack by small chains fastened to the wall. For the convenience of the operator the instructions for testing are framed and secured to the wall



Compact, permanent arrangement for testing whistle valves

to the left. The gage for observing the pressure is directly above the valve cap bracket and cap which are permanent parts of the rack equipment.

One hour, twenty-four minutes was the time required recently by H. W. Lehr's crew, at the Thirty-second street repair shop of the Pennsylvania Railroad, at Pittsburgh, Pa., to take out the 12 wheels of a dining car and put other wheels in their places. This was in an emergency when a diner which had started on a special run from Philadelphia to San Francisco had its wheels flattened, because of an emergency application of the brakes, at a point east of Pittsburgh. Mr. Lehr's crew consisted of A. C. Hussong, A. Dawidowicz, J. Bruszak, J. Pavlovic, M. Dvorabic, J. Koss, J. Starkowitz, F. Pasko, P. Sikora, C. Belancey, P. Starkowitz, R. Cillo, J. Stacherski, J. Lujic, J. Majkut, L. M. Bauer, J. Kozak, G. W. Euler, F. C. Johnson, J. Grosiak, A. Teofilak and S. Pluto. The train waited for the car.

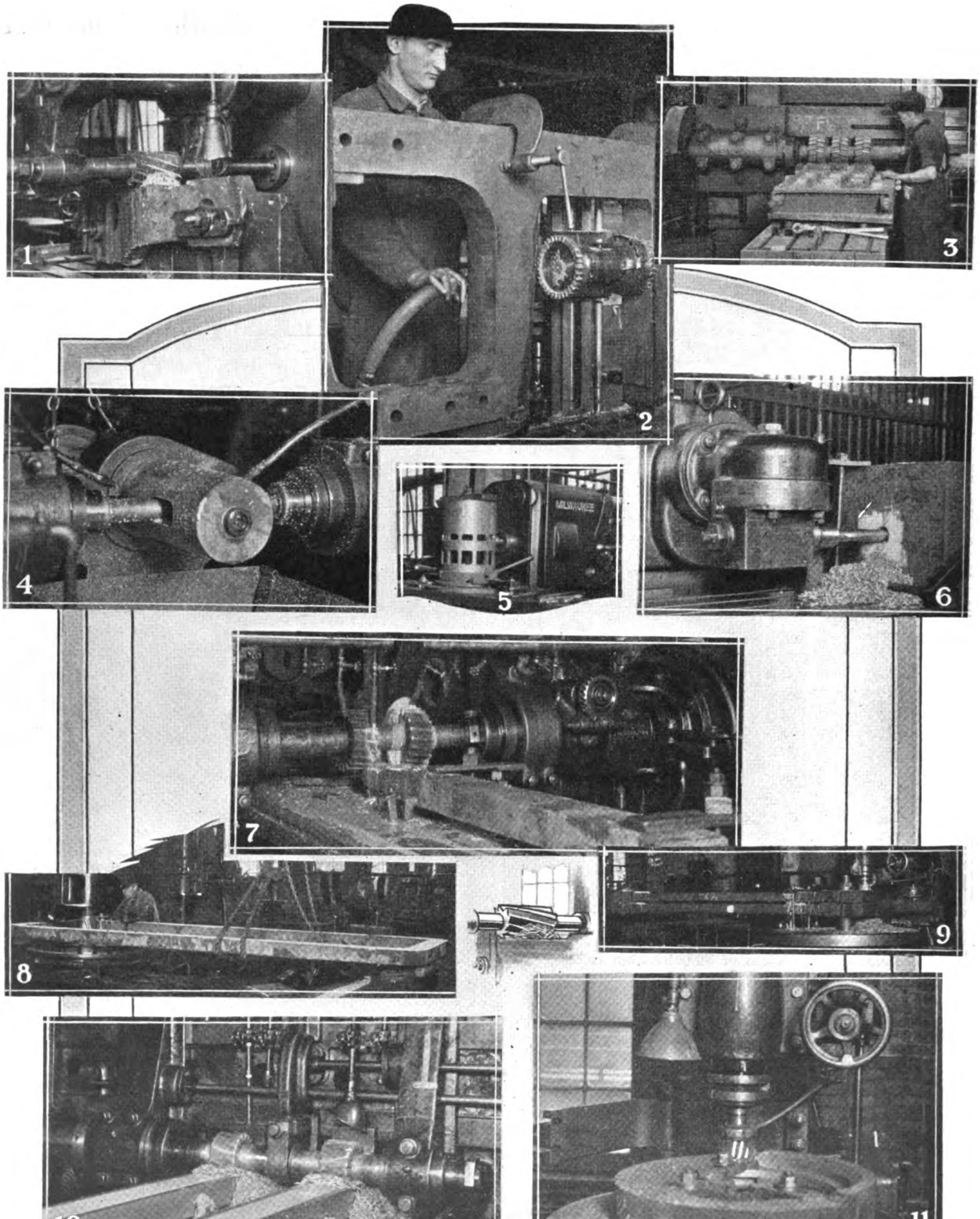


Fig. 1—Milling contour of eccentric crank arm; Fig. 2—Facing driving box pedestal jaws; Fig. 3—Milling crosshead shoes; Fig. 4—Milling keyway in piston rod, using a helical cutter; Fig. 5—Middling ports in valve chamber bushing, using an end mill; Fig. 6—Cutting a die on a milling machine, using a special attachment; Fig. 7—Milling sides of crosshead guide, using a straddle cutter; Fig. 8—Milling the corners of a mud ring on a vertical miller; Fig. 9—Profiling the ends of two main rods at one set up; Fig. 10—Cutting channels in two main rods on a horizontal miller; Fig. 11—Milling the fit in a piston head rim.

Milling machines in railway shops

Classes of work for which they are fitted, cutters of proper design and lubrication are important considerations

By Leroy R. Gurley

SEVERAL articles appeared in the *Railway Mechanical Engineer* in 1917 and 1918, dealing with the subject of milling machines in railroad shops. Without exception the introductory paragraphs of these articles lamented the fact that the railroads were backward in more generally applying milling processes to certain classes of work. The articles were enthusiastic over the possibilities of the economies effected by machining certain classes of work on milling machines which then were usually done on the planer, shaper or slotter.

On investigation of present day milling machine practice in railroad shops over that of eight years ago, it has been found that the railroads have appreciated its possibilities and are applying its principles to the work for which it is suited. Within the past eight years, various sizes of horizontal and vertical millers have been placed on the market for handling large pieces of work such as rod and link motion work. This work was formerly done on the planer or slotter. However, this does not mean that the milling machine is always more effective than the planer or slotter, because for many operations these machines are better adapted. When single parts are to be machined, the time required to set up and perform the operation on a planer is less than when setting up the work on a milling machine and getting milling cutters of the required shape and size to perform the work. For the quantity production of many duplicate parts, however, the milling machine cannot be equalled.

Types of milling machines used in railroad shops

The milling machine was originally developed for manufacturing the small, irregular shaped parts used in the construction of fire arms and the milling process is still employed very extensively in the production of similar work, especially when the parts must be interchangeable. Milling machines are used for a great variety of operations and many types have been designed for finishing specific classes of work to the best advantage. They are widely used at the present time in the railway shops for milling many large castings or forgings which were formerly finished exclusively by planing; in fact, it is sometimes difficult to determine whether certain parts should be planed or milled to secure the best results.

The four principal types of milling machines used in the railway shops are the plain, universal, horizontal and vertical. The names used distinguish different classes of milling machines and indicate some additional feature that is characteristic or they may relate to the nature of the work for which the machine is intended.

Plain milling machine.—This type has a horizontal cutter spindle and is of the column and knee construction, which means that there is a vertical column, and a knee which is fitted to guiding ways on the face of the column, to provide vertical adjustments for the work table. Plain milling machines are commonly used for milling operations which can be performed by feeding the work in a straight line either vertically or in a horizontal plane, although in modern practice there are many exceptions to this rule. In the last few years, a number of improvements have been made in the plain milling machine that have added to its adaptability for railroad work and the two more important of these are greater power to drive the cutters to the limit and quicker methods for changing speeds and feed so that either can be readily adjusted for any particular part to be machined. These two improvements are especially valuable in railroad work, because a long run on one job cannot be expected.

Universal milling machine.—A universal type of milling machine is so named because it is adapted to a very wide range of milling operations. Its construction is similar to that of a plain milling machine although a universal type has certain attachments which plain machines do not ordinarily have, that make it possible to mill a large variety of work. This type has a knee which can be moved vertically on the column and a table with both cross and longitudinal movements. There is a difference, however, in the method of mounting the table on the knee. The table of a plain machine is carried by a saddle which is free to move laterally but does not permit the swiveling of the table. The swiveling base of the saddle of the universal machine makes it possible to do work such as helical milling which can not be done on a plain machine unless a spiral milling attachment were used that provides an angular attachment for the cutter. Practically all machines of this type are equipped with auxiliary appliances such as the dividing or indexing head, vertical milling attachments, etc. The universal milling machine is usually found in the tool room of the railroad shops.

Horizontal milling machine.—Any milling machine equipped with a horizontal spindle may be classified as a horizontal type but this name is generally applied to designs which have a horizontal work table, like that of a planer, and a horizontal cutter spindle. There are exceptions, however, to this classification. When a machine has a horizontal work table and bed, but is equipped with vertical spindles, it is termed by some manufacturers "a vertical spindle, horizontal machine." When the horizontal design of the planer type has a single spindle carried by a column at one side of the work table, it is sometimes known as the open side type or as a single spindle side head type. A machine designed in this way is also called a rotary planer, especially intended for milling plain surfaces or for slabing operations by using a large inserted tooth cutter head. This type of machine is generally used for heavy milling operations such as milling and fluting main and side rods.

Vertical milling machines.—When an end mill is driven directly by inserting it in a spindle of the plain type, it is difficult to mill some surfaces, especially if much hand manipulation is required, because the mill operates on the rear side of the work where it cannot readily be seen when one is in the required position for controlling the machine; moreover, it is frequently necessary to clamp the work against an angle plate to locate it in a vertical position or at right angles to the end mill when the latter is driven by a horizontal spindle to overcome these objectionable features. Special vertical milling machines have been designated. These machines are usually designated as

adjustable rotary milling machines and are especially adaptable in the railroad shop for such work as rod ending, strap profile milling and milling out side rods.

Milling processes

Some of the more general milling operations are classified either in accordance with the type of milling cutter used or the name given. A certain operation may indicate the method of presenting the cutter to the work. For instance, there are operations known as face milling, angular milling, form milling, etc. Some milling operations are associated with a special type of machine, whereas others merely indicate the type of cutter used or a certain method of milling. The following definitions are believed

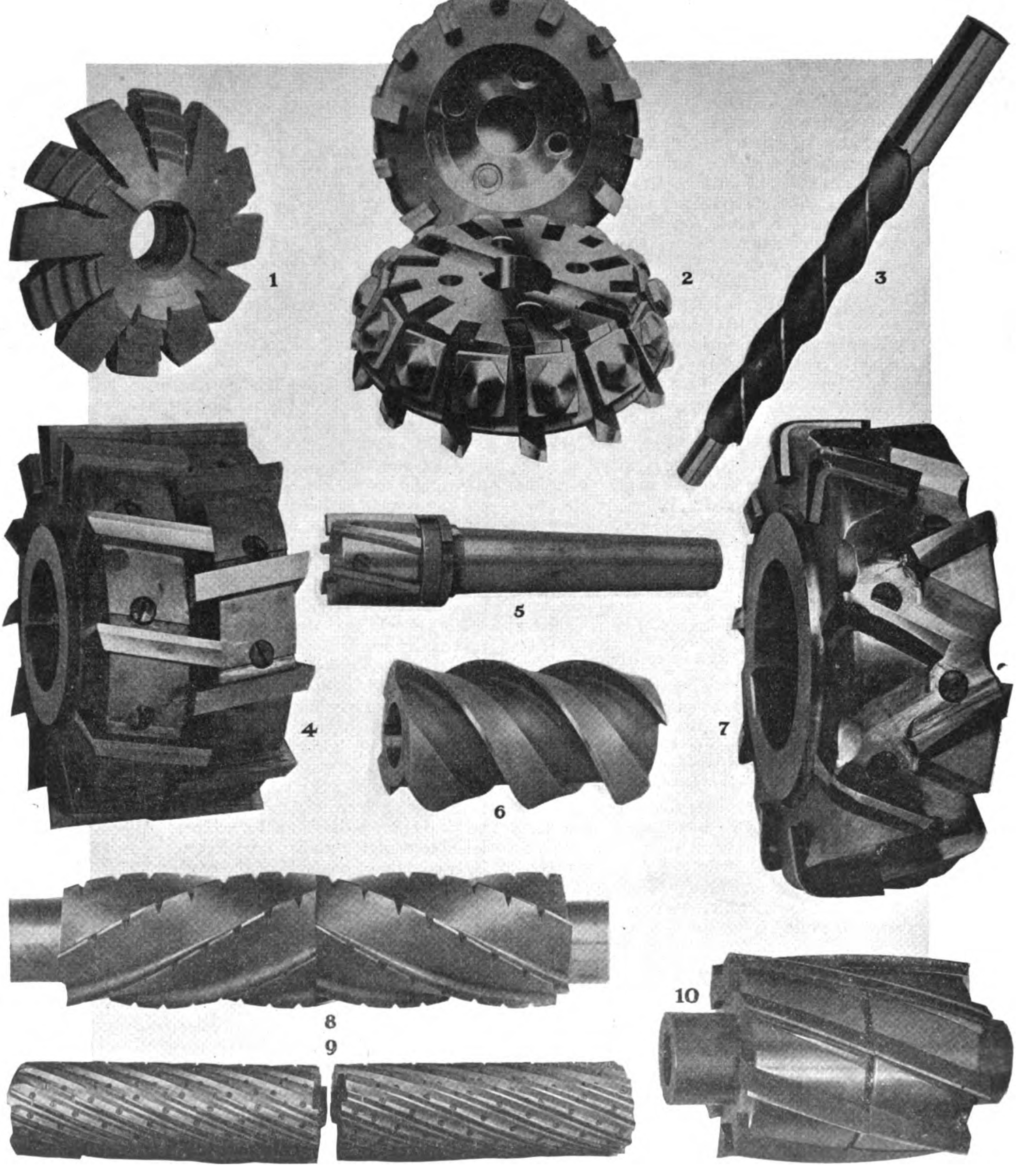


Fig. 12—Cutters used on milling machines in railroad shops

(1) Large cutter for milling involute gear teeth; (2) Inserted tooth face miller for heavy work; (3) Helical cutter for milling rods; (4) Inserted tooth interlocked cutters for milling shoes and wedges; (5) Spiral inserted tooth end mill; (6) Helical mill of the hole or arbor type; (7) Inserted tooth cutter for channeling main rods; (8) A pair of plain, niched tooth cutters mounted on an arbor; (9) Inserted tooth slab cutters for milling driving rods; (10) Inserted tooth cutters

to conform to general practice, although in some cases there is no generally accepted agreement regarding the use of these terms.

Face milling, as the term is generally used, means the production of a plane surface by the teeth of a milling cutter which operate in a plane at right angles to the axis of the cutter.

Gang milling means that surfaces in different planes are milled simultaneously by a combination or gang of two or more cutters.

End milling is a term usually applied to milling operations requiring an end-mill, as, for example, the cutting of slots, facing narrow surfaces, etc.

Straddle milling is an operation requiring the use of two side milling cutters which are spaced on the arbor a definite distance apart, in order to finish two or more parallel surfaces simultaneously.

Angular milling relates to the machining of surfaces which are at an angle neither perpendicular to nor parallel with the axis of the milling cutter, the teeth of the cutter being inclined the required amount.

Form milling is a method of producing a surface which may either be curved or of irregular shape, by using a formed cutter the teeth or the cutting edges of which conform to the shape required.

Slab milling is a term which is generally understood to mean the machining of comparatively broad flat surfaces, either by means of a cylindrical cutter or a face-mill.

These milling operations are the ones more commonly used on milling machines in the railroad shop. Profiling and routing are operations which are used in the railroad shops only in rare instances.

Milling cutters

To secure the most economical utilization of milling machines, it is imperative that properly designed cutters be used for each milling process. There are many shapes and sizes of cutters, a group of which are shown in Fig. 12, but they may all be classified under a few principal types.

The improvements in milling cutters adapted for railway practice and other work have been remarkable in the last few years and have contributed greatly to the present success of milling. The cutters of a few years ago had teeth spaced from 1/4 to 3/8 in. and many are in use today, the faces of the teeth being cut radial from the center. The teeth were generally all straight or only slightly spiral and, except on form cutters or gear cutters, they were rarely ground on the cutting face. It was generally thought that it was necessary to have fine teeth in order to obtain smooth surfaces, but it has been found that the slight irregularities in the finished surface are revolution marks and have no relation to the number of teeth in the cutter. For instance, it has been found that if feeding 1/16 in. per revolution of the cutter, the irregularities or slight depressions in the surface are 1/16 in. apart; if the feed is 1/8 in. feed, then the depressions are 1/8 in. apart, etc.

The cutters now largely employed for flat surface milling have teeth spaced from 1 in. to 1 1/4 in. and cut a spiral of about 25 deg. The face of the tooth is undercut or given a rake of from 7 to 10 deg., the cutting face and the top of the teeth being ground after hardening. All sharp corners at the bottom of the tooth are avoided. These are essential features of a cutter of maximum strength to cut and remove metal quickly with the least consumption of power, and at the same time to produce a satisfactory finish.

The plain milling cutter is cylindrical in shape, with teeth either straight or spiral. The teeth are generally niched at intervals along the cutting edge to break up the chips. The maximum diameter of these cutters is about 4 1/2 in., above which the inserted tooth type are used.

The side milling cutter, also known as a straddle cutter, because a cutter of this type is frequently used in pairs for straddle milling, are cutters commonly used in railroad practice. This type is provided with teeth on both sides as well as on the periphery of the cylindrical surface. Side milling cutters are used for cutting grooves or slots, as well as for many other operations. They are often used in conjunction with other forms of cutters for milling special shapes in a single operation.

Inserted-teeth milling cutters are widely used in railroad shops. The advantages claimed for this type of cutter are that considerable can be saved in its construction by making the body from machine steel and that the teeth can be readily renewed in case of breakage, which cannot be done with the solid type. The objections to this type of cutter are the difficulty of obtaining sufficient spiral, lack of chip space and liability of breaking the teeth. The latter objection is generally overcome by making the teeth amply large.

End-mills are used in railroad shops for cutting ports in valve chamber bushings and similar work. They are provided with teeth both on the cylindrical surface and on the plain end surface; this permits them to cut in an endwise as well as in a sidewise direction.

Face mills, in railway work, are useful for milling driving box cellars and a number of castings used on the locomotive and tender. They work equally well if made solid or with the inserted teeth. Since, in face milling,

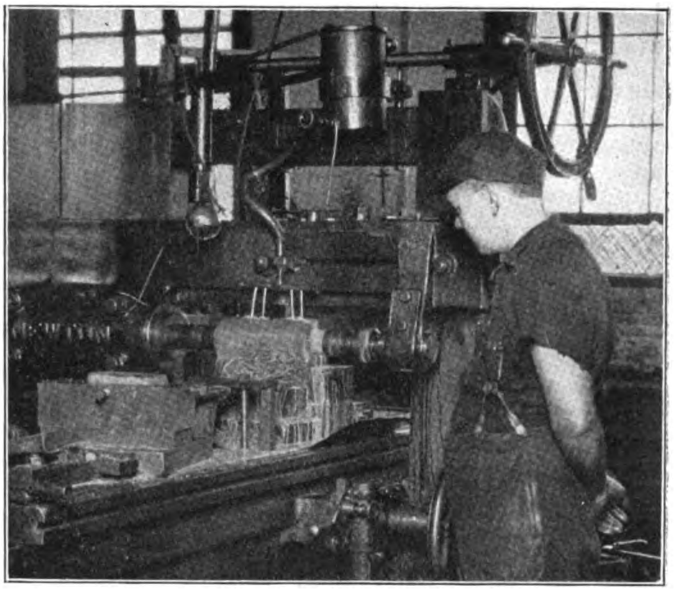


Fig. 13—Milling a link bracket on a horizontal miller with the cutters completely covered with the lubricant

practically all of the cutting is done by the periphery of the cutter, the teeth should have the same degree of rake and angle as the slab mill for rapid cutting.

The helical type of cutter is one which was especially designed for the railroad shop. The shank type is primarily intended for internal finishing, either working from a drilled hole or working in from the end of the piece. The steep spiral with which these cutters are designed gives them a shearing action that enables the cut to be taken easily while maintaining a good finish. At the same time, the undercut teeth contribute to the free cutting action, and require less power for driving. These cutters are generally used in the railway shops on vertical or horizontal millers for cutting out of the solid the back

and front ends of main rods. Fig. 12 shows a group of various types of milling cutters used for different classes of work in the railroad shops.

Grinding cutters

The use of properly ground cutters is especially essential in order to obtain the maximum output of milling machines, and unless this is attended to, high rates of speeds and feeds cannot be expected. Considering for the present the outside of the tooth, it is very necessary that it be ground to give the correct amount of back clearance. Too sharp an angle will cause the cutter to chatter, hook in and produce rough surfaces. Too little clearance will cause the cutter to drag and prevent proper cutting. Many cutters have been condemned on account of too sharp teeth or angle, where a slight removal of the keen edge either by grinding or wear would have remedied the trouble. No hard and fast rule can be given governing the amount of clearance, as different metals will require different degrees. For steel such as used largely in locomotive construction, a back clearance of about three degrees appears to be satisfactory for a 4½-in. cutter. It is a good plan occasionally to measure this back clearance, which can readily be done by a bevel protractor. The data obtained will be available for grinding future cutters. Sheet steel gages made to the proper angle for testing cutters after being ground will be a great help. When a happy medium has been arrived at for grinding the back angle, it will be found that cutters as they come from the grinding machine will start off at once to full capacity without the nursing often necessary with improperly ground cutters. Some of the cutter grinding machines are arranged so that the amount of back clearance can be adjusted.

To grind the front rake of a tooth or the undercut surface is somewhat difficult on the average universal grinding machine, but it can be performed in a fairly satisfactory manner by setting the grinding spindle at right angles to the groove in the cutter and using a cup grinding

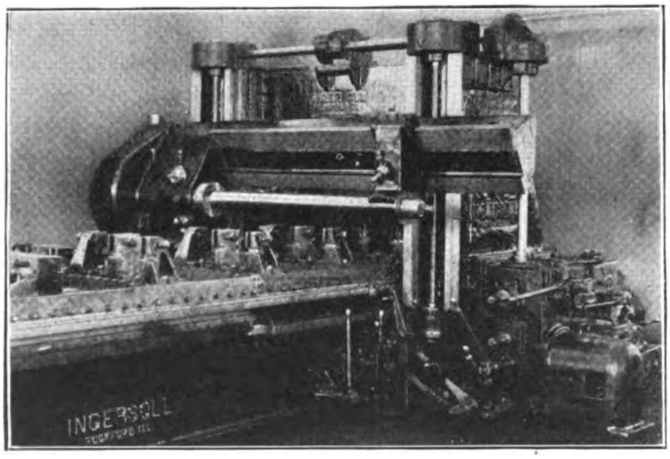


Fig. 14—Fixture for holding almost every style of locomotive driving rod

wheel. The cutter must be passed back and forth holding its face against the wheel. Some of the latter grinding machines are equipped with spiral grinding attachment that will grind this surface nearly perfect. Even with the hand method, however, the results obtained in the way of longer life between grindings, fully justify the additional expense of this one grinding. The grinding of the face of a tooth may be likened to the grinding of the top face of a lathe tool. Who would think of making use of a lathe tool that had not been ground on the face after hardening? A smooth surface is absolutely necessary to prevent the chip dragging on the lathe tool or the cutter tooth face. The question as to how often a cutter should be ground may be answered by observing the chips. When these show a discoloration in spite of a liberal supply of compound it usually indicates that the cutter teeth are either dull or broken.

Lubrication of cutters

One of the greatest factors for efficiency in milling is the proper lubrication of the cutters. Without some good means of cooling, it is impossible to approach the maximum amount of work possible with any design of cutters, because the limit of speed is reached when the cutter burns. It has been demonstrated that the nature of the lubricant is of minor importance so long as a sufficient quantity is provided. The newer milling machines are equipped with a system of lubrication that floods the cutters, which is very effective. Fig 13 shows a link bracket being milled on a horizontal miller with the cutter completely covered with the lubricant.

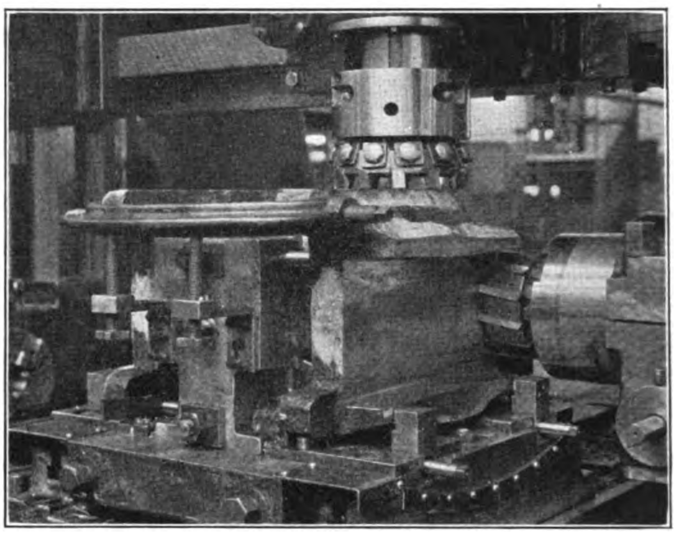


Fig. 15—Special fixture for holding driving boxes while milling three sides simultaneously

Holding fixtures

The use of holding fixtures plays an important part in obtaining the maximum production from milling machines. For single purpose machines, they are indispensable not only in time saved in quickly loading the piece and holding it securely, but by allowing an unskilled workman to operate the machine, as the fixture has fixed points for locating the work when setting up. For general purpose machines, the necessity for the fixture is not so great. However, in nearly every shop, there are certain pieces that are coming to the milling machine from time to time for which it pays to make special fixtures, and there may be a considerable number of pieces not alike, yet somewhat similar, that may be held by combination fixtures made of crossbars, screw jacks side stops and clamps.

It was found for example, on a slab milling machine that the time of loading and setting up locomotive rods without fixtures was greater than the time used in actually milling the work. This situation was corrected by making the combination fixture shown in Fig. 14 which holds almost every style of rod. The special fixture shown in Fig. 15 for holding driving boxes while milling the three sides simultaneously with inserted tooth facing cutters is adjustable to various sizes of boxes.

Milling locomotive parts

The work performed on milling machines can be segre-

gated according to the types of millers. Main and side rods, link motion levers, driving box shoes and wedges, etc., are usually finished on the horizontal or vertical miller, while gears, taps, etc., are completed on the plain or universal millers. The former machines are located in the main part of the repair shops while the latter are generally found in the tool room.

The work now handled by the two heavier types of machines was formerly finished either on the planer, slotter or shaper. Several factors must be considered when transferring the work from older types of machines to the millers. These factors are (a) the large percentage of the total power consumed by the actual cutting of the metal instead of moving the part machined and the machine table back and forth; (b) the continuous cut; (c) the reduction in time required for tool setting and grinding of the tools. The fact cannot be overlooked on the planer, slotter or shaper, that there is only from one to four tools cuting while the milling machine will have from 12 to possibly 26 cutting points. The milling machine cutter, with the greater number of cutting blades, can be removed and replaced in practically the same time it takes for the one tool on the three older types of machines. A comparative time study should be made of performing the work on the different types of machines which would show whether it would be an economical move to transfer the work. Table I shows the time, from floor to floor, of machining various parts on the horizontal and vertical millers.

Table I—Time required for milling locomotive parts on the heavier types of milling machines

	Material	Kind of operation	Cutter speed, r.p.m.	Table feed, in. per min.	Time to complete, hr.	min.
Axle box housing	Cast steel	Mill top and bottom inside faces	38	3⅛	0	25
Connecting rod	Forged steel	Mill from solid, 6-in. by 8-in. brass fit	148 (rough) 228 (finish)	⅞ 3¼	1	35
Crosshead	Cast steel	Mill underside, radius and fillet	30	variable	1	35
Crosshead gib	Cast iron	Mill fit	65	7¼	0	25
Crosshead guide	Steel	Mill bottom, top and offsets	60 (rough) 74 (finish)	2 5⅝	4	0
Crosshead guide	Steel	Three faces	16	1⅛	1	30
Driving box cellar	Cast iron	Mill sides	32	4¼	0	14
Driving box fits	Babbitt	Mill both faces	..	4.2	0	12
Driving box wedges	Cast iron	Nine milled inside	..	..	0	45
Driving box wedge	Cast iron	Mill five surface with gang cutter	20	7¼	0	8
Driving box shoe and wedge	Cast steel	Two pieces, finished inside	12	..	0	38
Eccentric blade	Forged steel	Mill top and end	65	7¼	1	38
Eccentric crank	Steel	Mill contour	59	1 3/16	4	0
Facing pedestal jaws	Steel	Both jaws	24	11/16	1	35
Link saddles	Forged steel	Mill to surface	35	½	0	40
Main rod brass	Brass	Mill sides	183	5⅝	0	45
Main rod key	Mild steel	Mill rounded edge	..	..	0	20
Mud ring	Steel	Mill four inside corners	..	..	8	0
Main rod	Steel	Milled on all four sides and fluted	21 (for fluting)	3/16	12	0
Main rods	Steel, H. T.	Profiling both ends of two rods	..	..	10	0
Main rods	Steel, H. T.	Two rods milled complete	..	..	20	0
Piston head rim	Cast iron	Mill fit	..	..	0	35
Piston rod keyway	Steel	Mill 1⅝ in. by 4⅛ in. keyway	..	..	0	55
Side rod	Steel, H. T.	Profile front end	30	1½	0	30
Side rods	Steel	Profile both ends of two rods	..	..	2	45
Side rods	Steel	Mill both ends of two rods	28	⅜	4	0
Spring saddle	Cast steel	Mill feet	38	5⅝	0	9
Trailer spring saddle	Cast steel	Mill bottom, sides, ends and top ends	25	4¼	1	40
Trailer spring saddle guide	Cast steel	Mill fit	41	1⅝	0	28
Union link	Steel	Mill clevis ends	148	2⅛	0	40
Valve bushing	Gun iron	Eight ports	228	4¼	0	45
Valve bushing	Cast iron	Mill 11, 1½-in. by 2¼-in. ports	231	4½	0	30
Valve yoke	Steel	Milling bevel to fit fillet on slide valve	..	..	0	45

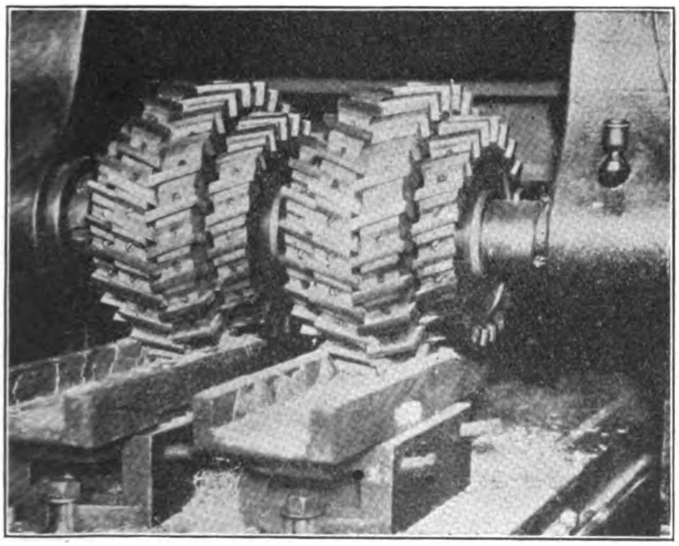


Fig. 16—Milling the guide bar fit of crosshead shoes using a gang of inserted tooth interlocked arbor cutters

The milling of driving box shoes and wedges on a horizontal miller using a gang of inserted tooth cutters is rapidly become general practice in railroad shops. Fig. 16 shows a double row of crosshead shoes being milled using inserted tooth arbor cutters and interlocking side milling cutters. On this machine, 60 shoes have been completed in eight hours. Fig. 3 shows another view of nine wedges set-up in three rows of three each which were finished complete inside, in 45 min.

To obtain the above results, the following factors must be considered. If a perfectly smooth finish is not considered essential, the milling cuts of shoes and wedges can be taken at the fastest speed the cutter will stand. With fairly good forgings and removing not over ¼ in. depth of cut, a cutter speed of 60 ft. per minute and feeds of 3 in. to 6 in. per minute, can be obtained, the rate of feed being largely governed by the ability to hold the wedge on the holding fixture. The thrust from the milling cutters on the wedge is heavy, as from 15 to 20 hp. will be consumed when milling to the limit of modern cutters on a surface of this kind. All the thrust of the cutter must be taken up by the wedge, and unless the piece is well secured, it is liable to shift or slip and damage the cutter. Therefore, it is advisable to make a holding fixture for this work.

After pouring the shoe and wedge face on locomotive driving boxes they must be machined to size. Many of the railroad shops are doing this work on a horizontal miller using two inserted tooth milling cutters. Fig. 17 shows a machine of this type with four boxes set up on the table. Forty boxes per eight-hour day, giving an actual cutting time complete per box of five minutes and a setting up time seven minutes, making a total of 12 min.

from floor to floor for each box, is considered good machine time for this work. The established feed to obtain these results is 40 ft. per min. for cutting speed, and 42 in. per min. for table feed. These speeds and feeds have proved desirable on this class of work as from 80 to 90 boxes may be machined with one grinding of the cutters.

The machining of crosshead shoes can be done to advantage on a horizontal miller. Fig. 18 shows a herring-bone type of crosshead shoe being milled on a horizontal miller. The body of this crosshead shoe is made of cast steel, while the recesses are filled with a soft metal, which gives an unfavorable surface to machine. This condition naturally requires a slower cutting speed. Notwithstanding this drawback, ten crosshead shoes are milled in an eight-hour day, using a table feed of 2 in. per min. and a cutting speed for the largest diameter of cutter of 40 ft. per min. An average of 18 crossheads are machined with one grinding of the cutters.

The machining of main and side rods on either a horizontal or vertical miller is considered the most economical method of doing this work. The rods first have their four sides machined on a horizontal miller. From two to six rods can be milled at one set-up, depending on the size of the rods. The next operation is to mill the flutes in the main rod. Fig. 10 shows two rods each having two 7-in. by 12-in. flutes milled complete in 12 hr. The rods were completed throughout in 20 hr. The next operation is to mill out and profile the back and front ends of the main rods and mill the contour of the ends of the side rods. Fig. 9 shows a radial vertical miller machining out the rear end of two main rods in two hours, and the back end in eight hours.

Crosshead guide bars are machined on a horizontal miller, using a gang of inserted tooth cutters. Fig. 7 shows the rough forging of a guide bar, having its two sides milled with a straddle inserted tooth cutter. By using a cutter between the two cutters shown, the top face and two sides can be milled at one operation in 90 min., using a table feed of 1⅜ in., and the cutters revolving at 16 r.p.m. Considerable time is saved by using the three cutters to complete the job in one set up.

The usual method of cutting the keyway in a piston rod is to drill, slot and hand file, which requires about three hours to complete. A milling machine has been designed, which will do this job in less than an hour. Fig. 4 shows a 5½-in. diameter piston rod having milled in it with a helical cutter a 1⅞-in. by 4⅜-in. keyway in 55 min., from floor to floor. This machine will also mill the keyways in crossheads. This is a single purpose machine, and its purchase is justified only for those shops which have a considerable amount of this type of work to do.

It is often necessary to face the pedestal jaws of a locomotive frame. To disassemble the frame and machine it on a planer would be an expensive operation. The pedestal facer shown in Fig. 2 is well adapted for this work. The actual time required to face the pedestal jaws shown in the illustration is as follows:

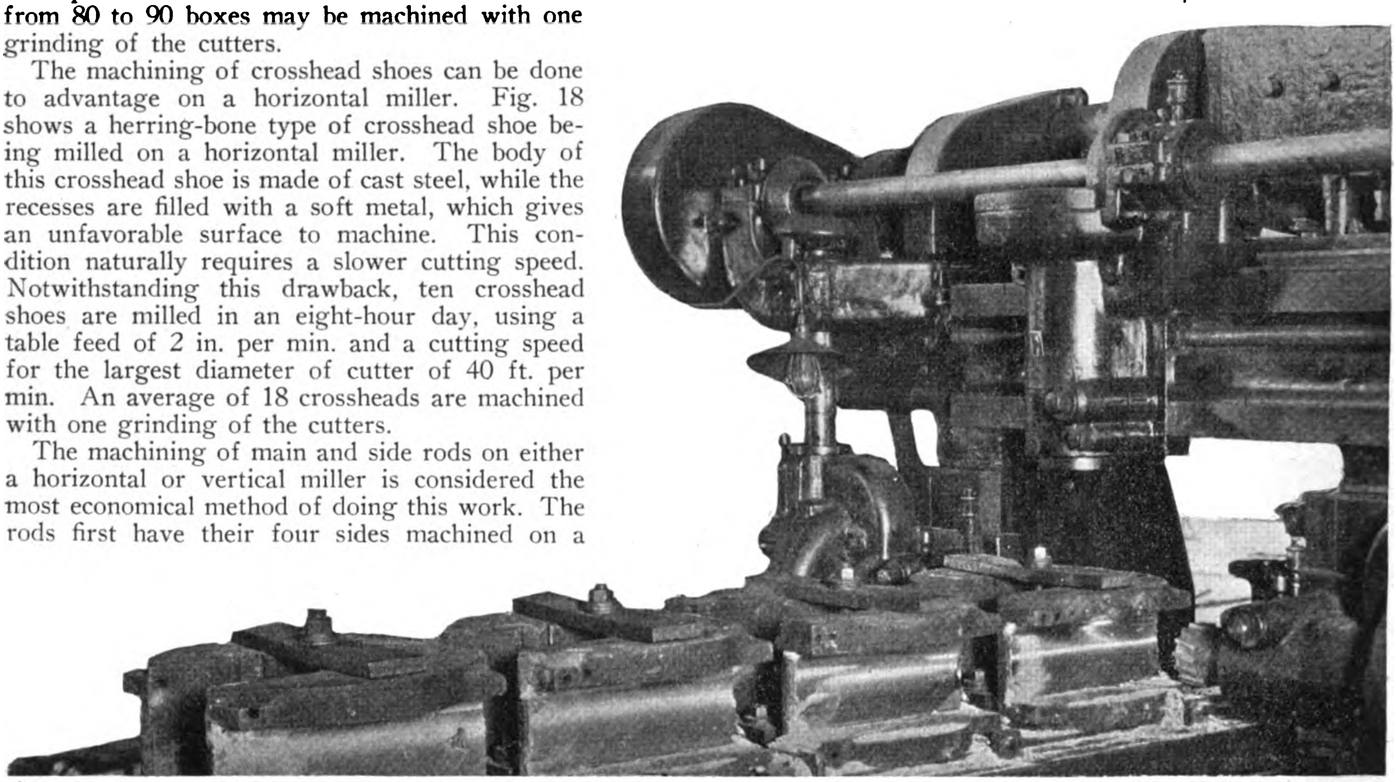


Fig. 17—Milling the shoe and wedge fits of driving boxes using two inserted tooth facing cutters

Set up the machine	15 min.
Facing the wedge side of the pedestal	40 min.
Facing the straight side of the pedestal	35 min.
Taking down the machine	5 min.
Total time	1 hr. 35 min.

A cut 1/16-in. deep was taken which required a cutter speed of 24 r.p.m. and a feed of 11/16-in. per min.

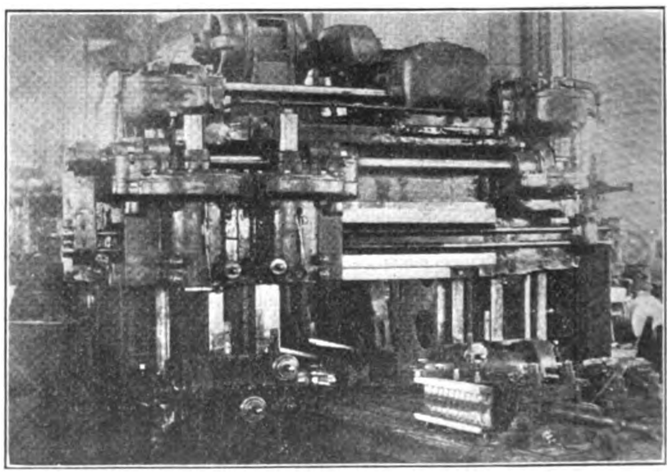


Fig. 18—Milling the guide bar fit on a herringbone type of crosshead

Fig. 11 shows a piston rim ring being milled in 35 min. on a vertical miller using an inserted tooth end mill. Another example of the application of an end mill may be seen in Fig. 5 which shows the milling of the ports

of a valve chamber bushing. This bushing contains 11 ports, 1½ in. by 2¼ in., each port requiring 2½ min. to complete, using a cutting speed of 231 r.p.m. and a feed of 4½ in. per min. By using a chuck which enables the operator to revolve the bushing quickly, the 11 ports were finished complete in 30 min.

The plain type of miller can be used to advantage in the repair shop as well as in the toolroom. Fig. 1 shows a machine of this type milling to the layout line in 4 hr. an eccentric crank using a cutting speed of 59 r.p.m. and a table feed of 13/16 in. per min. Another application of the plain miller may be seen in Fig. 6. By means of a special attachment a steel spring hanger die block in which a 2-in. diameter hole, 6 in. deep had to be milled, was completed in 3 hr.

Fig. 8 shows a vertical miller machining a mud ring which is an unusual job for this machine. The four ends of the mud ring are milled complete in 8 hr. after which it is placed on a planer and finished.

Milling machines in the toolroom

The first application of milling machines in railroad shops was in the toolroom. They were of the universal type and were used for repairing and manufacturing such tools as reamers and taps. Experience has shown that these earlier machines did not have sufficient capacity for handling some of the larger tools used in railroad work. Consequently, the toolrooms have been provided with the larger machines such as is shown in Fig. 19. In addition to regular tool room work, they are used for finishing machine repair parts and making holding fixtures, jigs and other special machine attachments.

Fig. 20 shows a universal machine milling a 4½-in. by 3¼-in., 14-thread hand tap. The same illustration shows a group of cutting tools which were made on this machine. They consist of three staybolt taps, six hand taps, one reamer, one hand bolt tap for frame equalizer spring bolt holes and one general tap. Referring again to Fig. 19 the top right view shows a staybolt tap being completed in 33 min. using a cutting speed of 40 r.p.m. and a table feed of 2 in. per min.

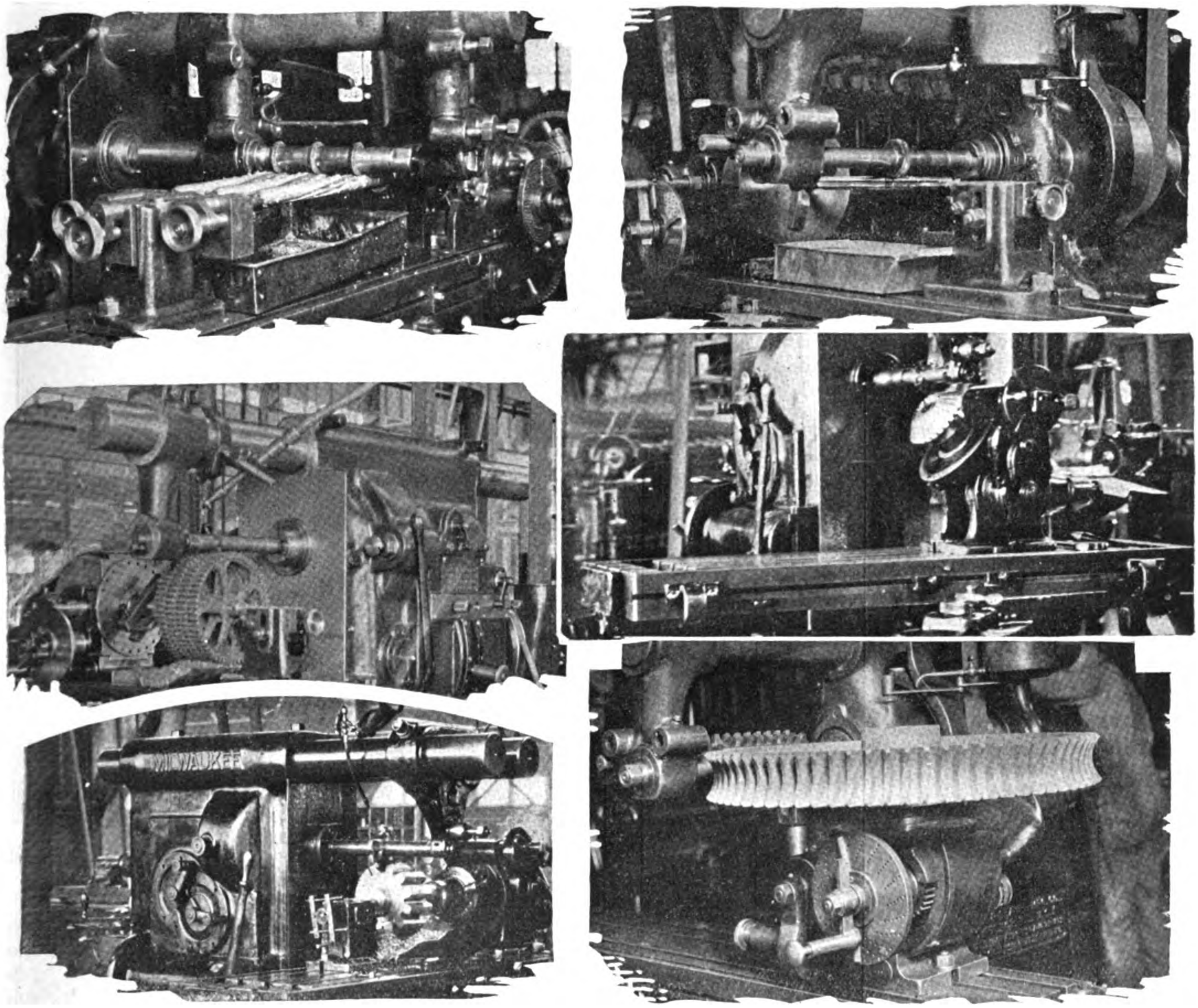


Fig. 19—Various types of jobs performed on milling machines in the railroad toolroom

One of the frequent jobs which a toolroom is required to do is the generating of various types of gears which are a part of a machine or other shop equipment. As these repair jobs are usually urgent, they are made in the toolroom instead of being purchased from a manufacturer.

The left-center view of Fig. 19 shows a universal miller

cutting the teeth in four cast-iron gears in 5 hr. using a cutting speed of 45 r.p.m. and a table feed of 1 in. per min. Each gear has 60 teeth 1 in. wide and .360 in. deep. The right-center view shows a miller cutting the teeth in a bevel gear, using an indexing head. The left-bottom view shows a miller generating the teeth in a heavy spur gear. The right-bottom view shows a universal miller cutting the teeth in the worm gear of a hoisting machine used at a car icing plant. This gear has 75 teeth, each with a 3-in. face and was completed in 12½ hr. The right hand view shows three reamers being milled at one set up.

The illustrations show only a few of the many jobs which can be machined in the toolroom on a plain or universal type of milling machine. The time required for machining other types of cutting tools and gears may be found in Table II.

Table II—Time required for milling cutting tools and gears on the plain or universal milling machine in the toolroom

	Material	Kind of operation	Cutter speed, r.p.m.	Table feed, in. per min.	Time to complete, hr.	Time to complete, min.
Staybolt tap	Carbon steel	Six, 23-in. flutes	40	2	2	33
Hand-tap	Carbon steel	Four, 4½-in. flutes	58	2½	0	32½
Spiral reamers	Carbon steel	Three reamers, nine flutes, 12 in. long	75	.036	0	32
Gears	Cast iron	Four gear, each with 60 teeth, 1 in. wide	45	1	5	0
Worm gear	Cast iron	75, 3-in. teeth	..	..	12	0
Drop forging die	Steel	Mill to size:	20	Variable	5	0
Spring hanger dies	Steel	Milled to line	..	..	3	0

Conclusion

The present-day tendency of mechanical department officers is to analyze the conditions in the repair shops so as to segregate certain classes of work and have them

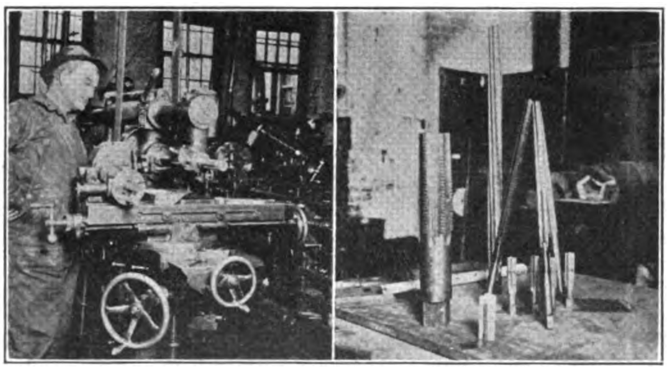


Fig. 20—Milling a hand tap on a universal milling machine—A group of cutting tools which can be made on a machine of this type

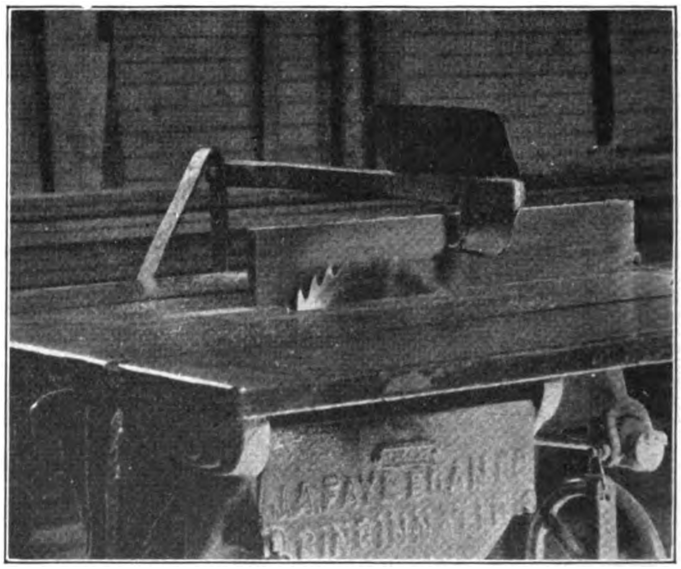
machined on machine tools particularly adapted for such work. A striking example of the results of such an analysis is shown in an article which appears elsewhere in this issue on "Rod and valve motion production," in the Aurora, Ill., shops of the Chicago, Burlington & Quincy. The shop was organized for handling new and old rod and valve motion work on a production basis and in which milling machines are extensively used. There are other locomotive and car parts which are now finished on other machines which can be more economically handled on milling machines. However, before changing over to the milling machine it is well to make an exhaustive comparative time study of performing the work on the different types of machines.

In analyzing shop conditions, it is common to find many parts which can be economically manufactured on a single purpose machine. This means that production methods and modern machinery should be installed and, with this thought in mind, the mechanical officers are giving considerable attention to the milling machine as a production tool.

A safety guard for circular saws

ONE of the most dangerous machine tools with which a carpenter has to work is the circular saw. There is always a possibility of a workman allowing his hand to rest too long on the piece he is cutting and receiving a nasty cut. It is practically impossible to use a wire-guard or cage of the usual type as such a safety device interferes with the work and it is usually taken off by the first man who happens to use the saw and finds the guard in the way.

A simple and effective device which has been designed with the special purpose of eliminating these difficulties is shown in the illustration. It consists essentially of a horizontal wood arm pivoted at one end to a bracket secured to the table and a guard of tin projecting upward and a guard of sole leather projecting down at the other

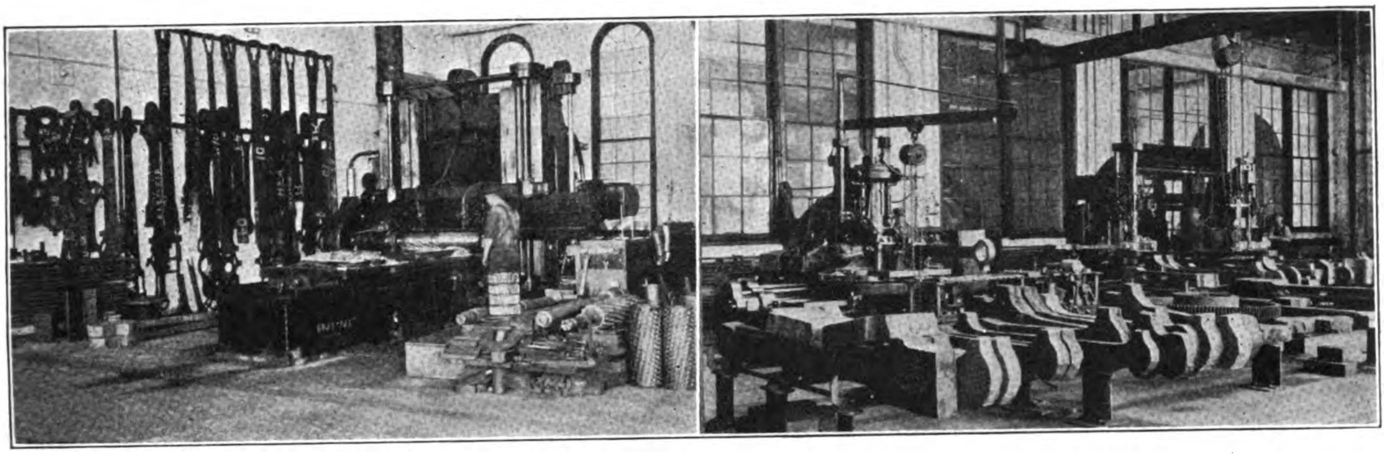


The top shield deflects flying saw-dust and the lower shield protects the head of the workman

end. The tin guard is used to deflect the saw-dust so that it will not fly into the eyes of the workman and the leather guard is used to prevent him from allowing his hand to slide onto the saw, and thus affording protection from possible injury.

There is practically no interference of the guard with the work, regardless of the size of the piece to be cut. When large pieces are being cut, the leather guard slides along on the work as it is moved forward past the saw, the sole leather being sufficiently stiff to raise the arm on its pivot.

THE INTERSTATE COMMERCE COMMISSION has granted a petition of the Chicago & Northwestern for exemption from equipping with automatic train control devices the locomotives of its Sioux City division operating between Maple River junction and Carroll, Ia., 3½ miles.

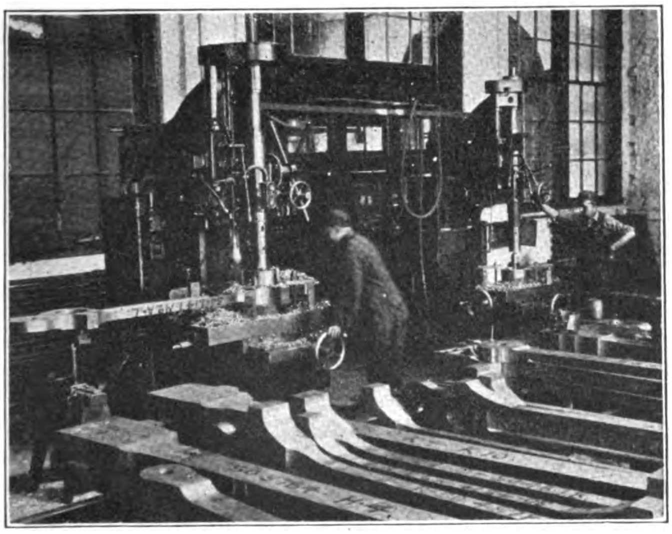


The Burlington rod shop is well lighted, the floor is clean and the work and tools arranged in an orderly manner. (Left) Heavy Ingersoll slab miller roughing out a pair of side rods. (Right) Roughing bench with Ingersoll heavy duty vertical miller and two Baker heavy duty rod drills in the background; overhead traveling crane will later be provided with an electric hoist and electric operation by push button control from the floor

Rod and valve motion production

Burlington organizes separate shop at Aurora, Ill., for handling new rod and valve motion work on a production basis

THE economies due to centralization of manufacturing work in a single plant or shop provided with modern machinery and trained men are well-known, and several railroads have taken advantage of these economies in handling certain phases of their shop work. The Chicago, Burlington & Quincy is believed to be one of the first, however, to organize a separate, fully-equipped shop devoted solely to system locomotive rod and valve motion work. Converted from an old boiler shop, this modern machine shop at Aurora, Ill., was placed in operation January 1, 1925, and, although certain additional machines and electrically-operated cranes are still to be installed, the new shop has already given a good account of itself. With a total force of 10 machine operators, two bench hands, one apprentice and two helpers, the following output was obtained in the first three months of this year: 32 new main rods, 142 new side rods, and heavy repairs to the rods on 60 engines. This shop is designed to manufacture all the new rods required for the entire system. The motion work is handled in one corner of the shop, as shown in the drawing, and, since the development of this part of the work has been somewhat delayed, a description of it will be deferred to a later issue, the present article being devoted primarily to methods of production in the rod shop.



Large holes are cut rapidly and accurately by the Baker drills equipped with three-cutter trepanning tools—Illustration shows a 12-in. hole being cut

New shop converted from old boiler shop

A new building was not erected for this rod shop but advantage was taken of an opportunity to convert the old 112-ft. by 75-ft. boiler shop at Aurora for this purpose. This shop was given a new cement floor, the walls painted white, traveling cranes overhauled, lighting improved, and in general every effort made to produce conditions in the shop most conducive to good output. Modern machinery was then installed, the location and type of each machine being shown in the drawing. The arrangement is such as to eliminate as far as possible all unnecessary movement and back travel of both material and men. The rods follow the course indicated by the dotted line, the forgings being received from the blacksmith shop, machined on the heavy millers, drills and slotter illustrated, completed on the finishing bench and delivered to the stores department for all points on the Burlington System.

The shop is now equipped with hand-operated traveling cranes, there being one over the heavy machines and roughing bench and another over the finishing bench. Plans have been made for the power operation of these cranes by means of push button control from the floor which will make possible a distinct saving in time and labor of handling the rods. Four helpers were required in the old rod shop for handling rods on trucks whereas one man is now able to do all this work in the new shop. In addition to the overhead crane, the heavy vertical spindle miller has a self-contained jib crane to assist in handling the rods for that particular machine. Another 20-ft. jib

crane provided in the corner handles rods for one of the Baker drills as well as the Sellers slotter.

While some old machines were located in the Aurora rod shop temporarily, most of the machinery installed was new, a list being shown in the table, together with those additional machines which will be provided in the 1925 budget.

Machinery installed in Aurora rod shop

No. of machines	Description
1	48-in. by 48-in. by 16-ft. Ingersoll slab milling machine.
1	36-in. by 36-in. by 12-ft. Ingersoll slab milling machine.
1	54-in. Ingersoll heavy-duty vertical milling machine.
1	5-in. Baker heavy-duty rod drill.
1	4-in. Baker heavy-duty rod drill.
1	72-in. Sellers slotter.
1	No. 4 Brown & Sharpe universal milling machine.
1	24-in. Bullard vertical turret lathe.
1	28-in. Cincinnati crank shaper.
1	24-in. by 8-ft. Boye & Emmes engine lathe.
1	C. B. & Q. 75-ton hydraulic rod press.

Additional machines to be installed in rod shop

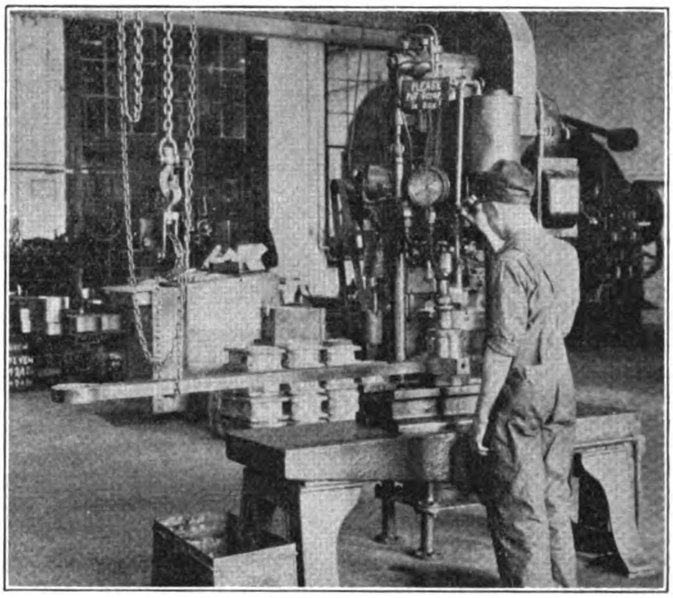
No. of machines	Description
1	18-in. by 48-in. engine lathe.
1	28-in. heavy-duty crank shaper.
1	¾-in., 2-spindle high-speed drill.
1	3-in. heavy-duty drill.

Factors promoting high production

Particular attention is paid to orderliness, neatness and clean floors at the Aurora rod shop in the thought that a better shop output will result, as well as decreased liability of accidents from stumbling over rod straps, brasses, tools and other materials often found laying around in a more or less careless fashion on rod shop floors. Rod racks are made from rails and cast iron stands and tool racks are provided for each machine.

Next to the arrangement of machinery in the shop and provision of proper crane facilities for handling the rods, perhaps the most important single factor in the shop output obtained is the elimination of hand fitting and filing. All rods are finish milled without filing, all brasses, both front and back end, being machined so that practically no hand fitting is required. The accuracy of the machine work and its influence in reducing the amount of hand fitting is indicated by the fact that two mechanics and one apprentice do all the bench work at the Aurora rod shop.

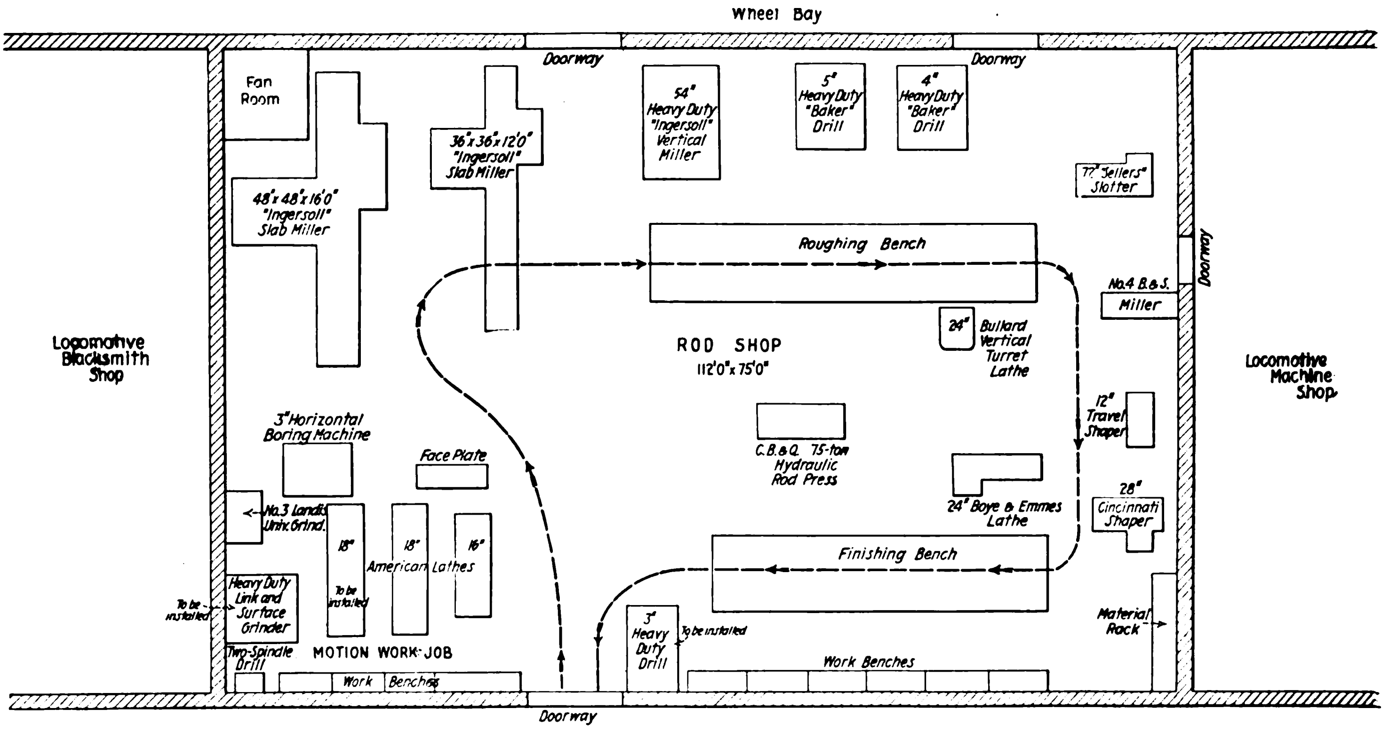
The labor and time involved in laying out is also minimized by the use of templates for new rods and straps. These templates are available for all classes of rods and straps and are kept hanging on the wall of the rod shop, as shown in one of the illustrations, where they are out



Burlington 75-ton hylraulic rod bushing press driven by self-contained 3-hp. motor and equipped with single plunger pump—Quick return of the ram is provided

of the way and there is no danger of their being damaged. It is stated that the use of these templates saves at least 1½ hr. work per rod in laying out.

In order to make the most effective use of the high power machine tools used in this shop it has been neces-

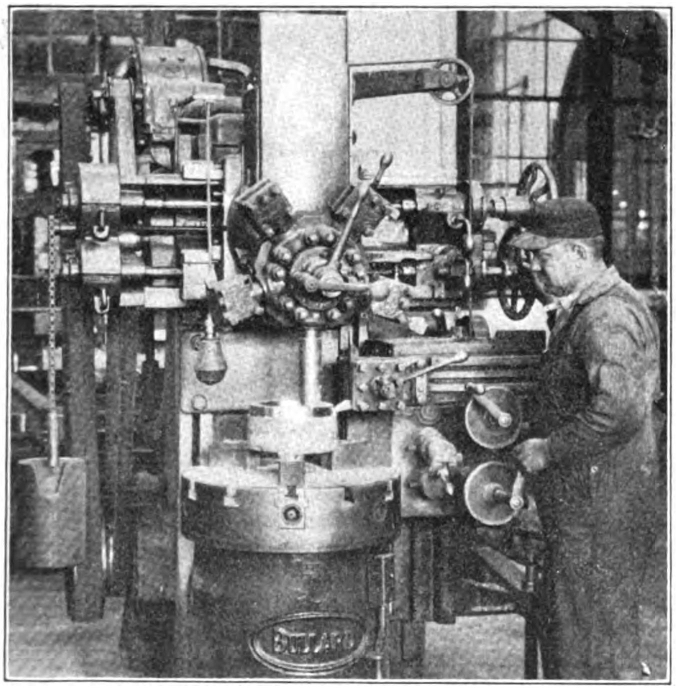


Floor plan of Burlington rod and valve motion shop at Aurora, Ill. The location of the machinery is indicated as well as the path followed by the rods through the shop from the time they are received from the blacksmith shop in the rough until delivered to the stores department finished

sary to pay special attention to the holding fixtures and methods of clamping the rods. These holding fixtures, some of which are illustrated, are featured by their rugged design, ease of adjustment and ingenious arrangement to hold different types of rods.

The question of milling cutter feeds and speeds is also highly important. While heavier feeds and speeds than those employed at the Aurora rod shop could probably be used, it is found that the actual cutting time is a fairly small proportion of the total time required for manufacturing rods so that it does not pay to use too heavy cutting feeds and speeds which will cause cutter trouble. More time can be saved by giving proper attention to methods of handling the rods and arranging for quick set-up and adjustment on the machine. The feeds and speeds mentioned later in this article are set about as high as permissible without causing excessive cutter wear and frequent grinding. About 12 cuts per grinding are secured.

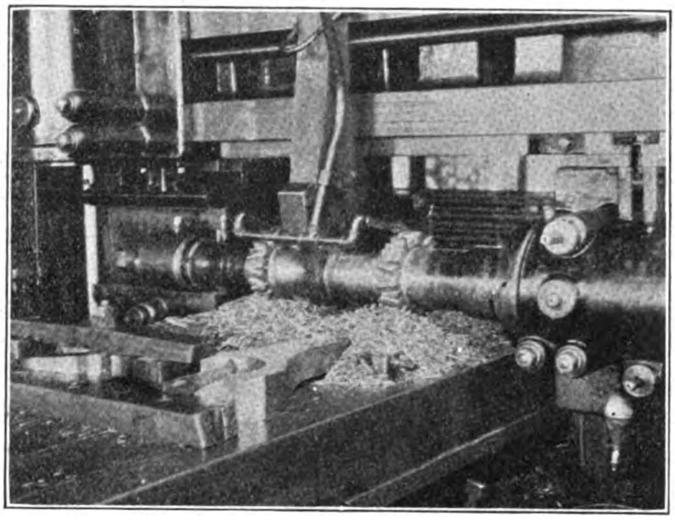
About 40 per cent of the Burlington rods are made of Nikrome steel. The 48-in. and 36-in. slab millers, driven by 75-hp. and 25-hp. motors respectively, are run at 45 ft. per minute on carbon steel rods and 35 ft. per minute



All rod bushings are machined on this 24-in. Bullard vertical turret lathe equipped with universal three-jaw holding chuck —The provision of the five-head turret and the side head to hold cutting tools, in conjunction with the convenient location of operating levers and hand wheels makes this a high production tool

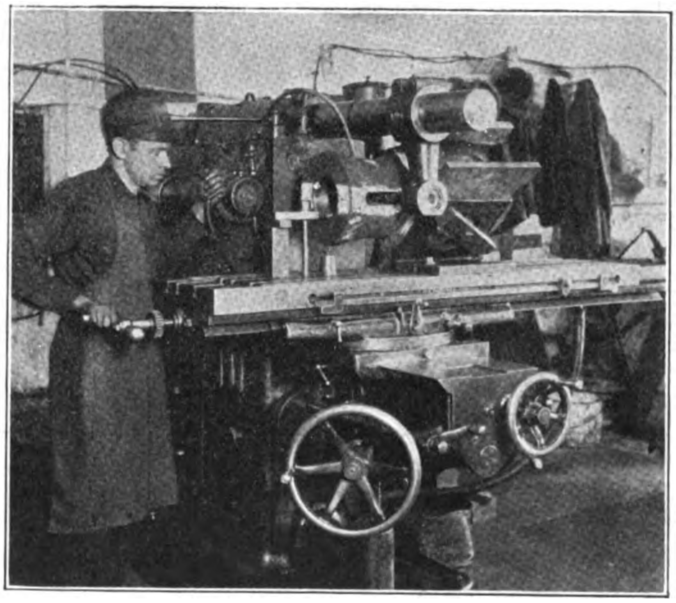
on Nikrome rods. The 48-in. machine is equipped with one 10-in. by 48-in. peg tooth milling cutter and one Goddard & Goddard inserted tooth slab milling cutter. The table feed, varying with the depth of cut, ranges from 3 in. to 8 in. per min. The rods are channelled with Helgren staggered-tooth solid milling cutters, ranging in width from 1¾ in. to 3½ in. The entire cut is milled in one operation, from ¾ in. to 1¾ in. deep, with a table feed varying from 2 in. to 3½ in. per min. Two rods are channelled at one time. These cutters are also interchangeable on the 36-in. by 36-in. slab millers.

The 54-in. Ingersoll vertical milling machine is equipped with 5-in. by 12-in. inserted tooth milling cutters and various sizes of solid milling cutters from 1 in. to 3 in. in diameter by 10 in. long for machining the rods outside and inside on the butt ends. Only one cut is taken on each end, no finishing cuts being required. Cuts on the ends of rods are taken to a depth of 2½ in., a 5-in. by 12-in. cutter being used which will permit milling two rods at a time. When cutting up to the full 12-in. length of the



Close-up view of 36-in. by 36-in. by 12-ft. Ingersoll slab miller machining the flutes in a pair of side rods

cutter it has proved advisable to reduce the feeds about 40 per cent. A feature of this machine, as shown in one of the illustrations, is the special holding fixtures which have an important bearing on the output secured. In view of the heavy cuts taken it is necessary to have unusually rugged holding fixtures and the factor of easy adjustment



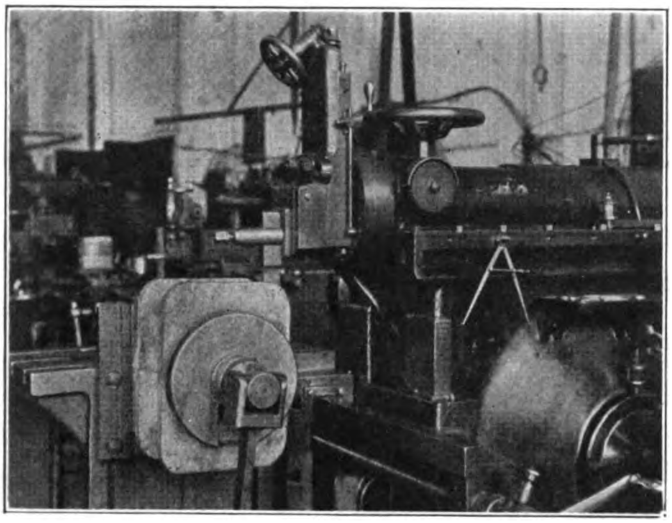
The No. 4 Brown & Sharpe universal miller is here shown machining a 1⅜-in. by 4¾-in. crosshead keyway—This machine also saves time in milling main rod keyways

to save time in setting up the work is also an important advantage. This machine, provided with a compound table with power operation in all directions, is especially built for rod work.

The heavy-duty Baker drills are also especially designed for rod work, having ample power and being equipped with push button control for starting, stopping and revers-

ing. All large side rod holes are cut by a three-cutter trepanning tool.

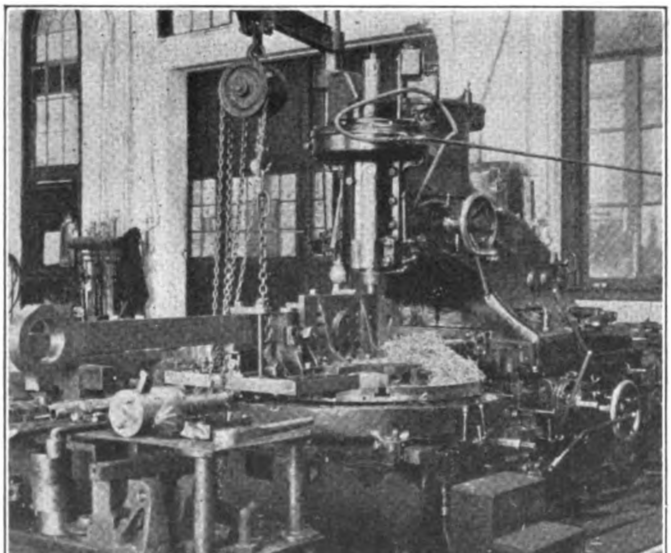
The 72-in. Sellers slotter, with power rapid traverse of the carriages and table and an ingenious method of obtaining exact speed control, is used for machining the



Main rod brasses are shaped accurately and with a considerable saving in time over older methods on this 28-in. Cincinnati shaper equipped with a Helgren indexing four-position chuck

insides of rod fork and front ends where the radius is so small that milling cutters cannot be used.

Main rod keyways are milled on the No. 4 Brown & Sharpe universal milling machine, crossheads and piston rods also being handled on this machine. Main rod key-

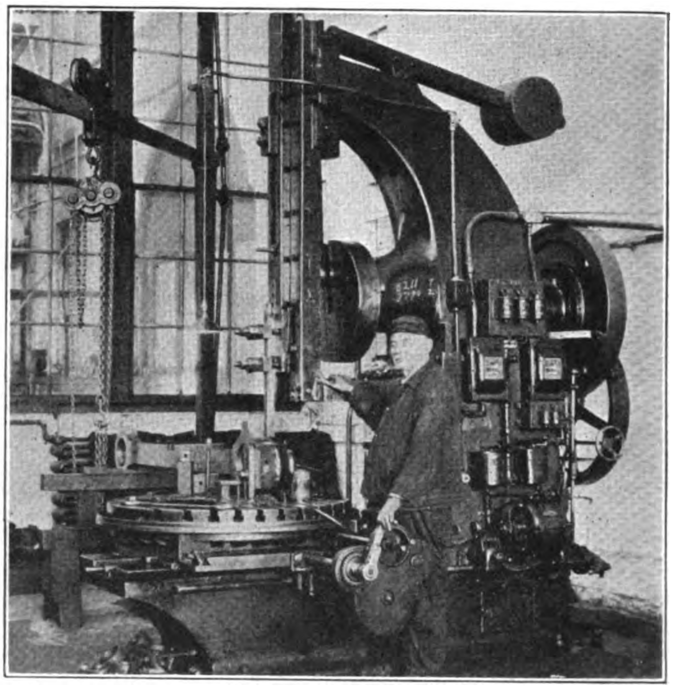


View indicating rugged character of the holding fixtures, which are also arranged for easy adjustments—The self-contained jib crane and chain hoist saves waiting for the traveling crane

ways 1 in. by 16 in. are milled in approximately one hour. Crosshead keyways, 1⅜ in. by 4¾ in. are drilled and milled complete in 1¼ hr. Piston rod keyways 1⅜ in. by 4¾ in. are milled in 45 min. This machine is said to do the same work in one-third the time required on a $12,000 machine.

The 24-in. Bullard vertical turret lathe is used for rod bushings and general rod and valve motion work. The Cincinnati 28-in. crank shaper, fitted with a Helgren rapid squaring and centering chuck, is used mostly for planing back end main rod brasses. A great deal of time is saved by this chuck and more accurate work is performed, enabling the brasses to be fitted on the machine to the exact size required for the rods. The time required for planing a back end main rod brass complete, fitted to the strap or the fork end of the main rod, is one hour. An additional 28-in. heavy-duty crank shaper will replace the 12-in. traveling head shaper shown in the drawing. The 75-ton rod bushing press is of Burlington make driven by a three-horsepower direct-connected motor. It is of the single plunger type with a quick return and handles readily the work in this shop.

Even a casual visitor at the Aurora rod shop of the



Fillets of too small a radius to be milled are machined on this 72-in. Sellers slotter—Easy power operation of the machine table in all directions is provided—The jib crane facilitates handling rods

Chicago, Burlington & Quincy can hardly fail to be impressed with the fact that this is a real production shop in which the production methods and machinery employed are on a par with those used in the best industrial shops in the country. The Aurora rod shop is conclusive evidence that the Burlington, like other progressive railroads, appreciates the importance of production methods in reducing the cost of repair shop operations and is applying these methods in cases where the volume of work involved is sufficient to justify them.

THE LOCOMOTIVE repair shops of the Pennsylvania at Sunbury, Pa., were closed on April 30. The lack of facilities for repairing large locomotives has necessitated the assignment of this work to other shops. Of the 200 men who are thus thrown out of work, many have already been given positions at other places. G. A. Schneider, master mechanic, retains his headquarters at Sunbury. Mr. Schneider is also master mechanic of the Schuylkill division. The first shop at Sunbury was built in 1865, and employed about 50 men.

A logical policy of locomotive maintenance*

Results of a study of economic factors determining the correct program of shopping cycles

By L. K. Sillcox

General superintendent of motive power, Chicago, Milwaukee & St. Paul, Chicago.

THE successful manufacturer must know the units of cost to produce his wares, for upon their application depends his profits. The universal adoption of more or less detailed cost accounts in both large and small establishments and the greater scrutiny given to them by owners and managers is real evidence of the value of such knowledge and the necessity therefor. Knowing that such information is successfully determined and applied in the commercial world, surely it can be as effectively established and employed in the matter of railroad locomotive maintenance and be the basis of executive policy with a view toward assisting the average motive power man in carrying out evident possibilities for economy and an eeffctive procedure at least cost.

Mechanical department economies are of two kinds: Internal economies which can be carried out independently by the mechanical officer of his own motion, and the much greater economies which management, as a whole, can only make possible, based on current studies as to policies and possibilities. Railroads are only typical of the more modern business organizations, and should seriously study, regardless of known obstacles, what the possibilities really are, and then constantly endeavor, item by item, to make progress along fundamental lines, all of which, for the purpose of our discussion, revolves around the question of the proper utilization of motive power. No one man, and indeed no combination of men, can evolve a best method off-hand from the foundation. It can only grow gradually, developing here and changing there, in line with economy, as the territory requires, or the nature of the traffic and competition in attracting the same becomes an issue. But the guiding idea of management having a proper and stable policy remains, nevertheless.

The expenditure for locomotive maintenance so far as it is caused by frictional wear and tear evidently will increase in direct proportion to the strain of the work done by the locomotive, and to the extent it represents outlay for replacement of parts, obsolete though not worn out, so far it is independent of the work done. Any plan used in the shopping of power involves complete considerations as to necessary maintenance and the effect from characteristics of service, as well as details of motive power construction, age and availability of shop, roundhouse facilities, etc. In not a few instances, much of the expenditure for locomotive maintenance, as reflected in the accounts, is occasioned from patching up old construction, even though in some cases this extends to the point where the actual repair cost, as renewed, exceeds the major portion of the value of the unit as renewed and, consequently, is recapitalized.

A close study will often indicate the folly of spending large sums per unit to continue obsolete designs in service for long periods when the same amount would be more than sufficient, as an initial cash payment, for an up-to-date efficient design of greater capacity and less cost to operate or maintain. Let us test by imagining a concrete case. Assume that a passenger engine 15 years old and originally designed to handle a nine-car train now is required to carry fifteen cars on the same schedule, resulting in a heavy maintenance cost due to frame breakages, racking of machinery, valve motion, running gear, etc., then it becomes a question not only of maintenance, but investment. If the original unit was of 40,000-lb. tractive force and was costing an average of $9,000 per year to maintain with a relatively low record of 3,000 miles per month, then it would seem proper to consider a new type of power, say with 50,000 lb. tractive force, which would afford 5,000 miles of service per month and yet not cost more than $5,000 per year for maintenance, making a saving of approximately $4,000 per year in maintenance cost and increasing the performance 66 per cent. This would justify making a change in power even though the original unit may have cost only $30,000 and the new unit $60,000. The original unit involved a maintenance cost of $9,000 per year plus a depreciation charge of $750 or a total of $9,750 as compared with an estimated maintenance cost of $5,000 per year for the new unit plus $1,500 depreciation charges or a total of $6,500, making a saving in the new unit of $3,250 per year, saying nothing of additional savings in fuel and transportation expenses. At 6 per cent this recovery would represent an investment of $54,000 or almost to the cost of the new unit, but if this were done on a large scale, then the amount of work would be performed with 66 per cent of the number of new units as compared with the number of old units and thus the change would be justified.

Two policies of shopping

There are many elements in the matter of executive policy which go to make a relatively high or low maintenance cost of locomotives, and the method of shopping power is one of the primary features to be considered. Two extremes of practice are found with many variations between them: One is what may be termed the high-frequency-shopping and the other the low-frequency-shopping policy. The former is that based on running locomotives through shops with an anticipated service of from 12 to 14 months with a minimum of roundhouse attention. The latter is that based on running locomotives through shops with the idea of having a service of 24 months or more and with a greater degree of roundhouse attention to attain this length of service. Vital elements in determining such a policy are the relation of the number and size of locomotives owned to the business handled, the road conditions for hauling heavy or light

*Abstract of a paper presented at the spring meeting of the American Society of Mechanical Engineers, held at Milwaukee, Wis., May 18-21.

tonnage trains, the topography of the country traversed, the distribution of industrial centers, the presence of large terminals, the spacing and capacity of roundhouses, the distribution and assignment of power, the placement of forces as between roundhouses and back shops, the rapidity with which mileage is run out and particularly the roundhouse and back shop facilities for handling certain classes of work. Furthermore, where a railroad has back shops of an obsolete character, it is practically as well off doing their work in roundhouses and it may be found helpful, under such conditions, to construct small modern back shop facilities at critical points to care for division requirements without increase in overhead expense.

The results obtaining under the two extremes of

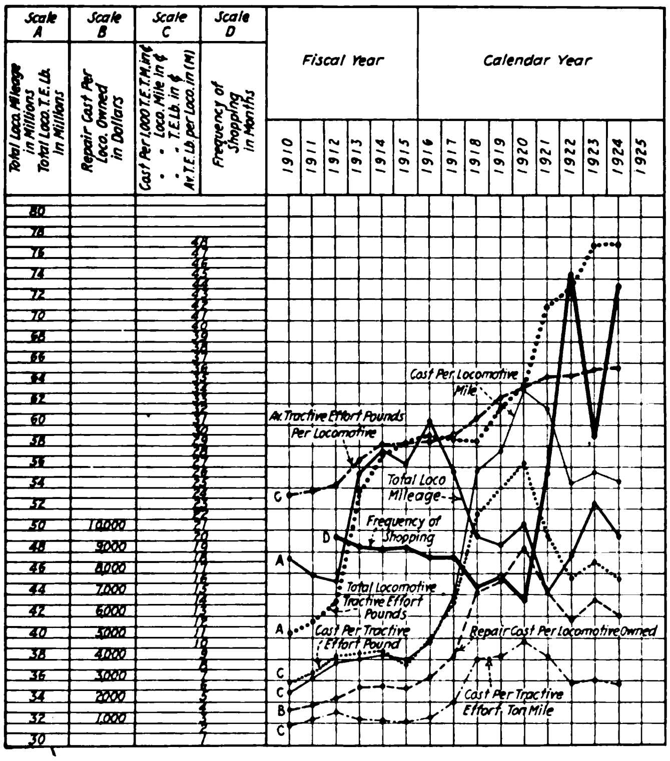


Fig. 1—Graphical illustration showing results of changing from a high to a low frequency shopping program on the C. M. & St. P.

policy mentioned have been observed for a considerable period and it appears that policy is largely governed by local conditions rather than local conditions being governed by the policy. The C. M. & St. P. has had experience under both plans, and just as a case in point, the general results obtained will be stated. Prior to 1921 a high frequency of back shop repairs was employed but after considerable study the plan was changed to a low frequency of repairs. The trend of unit costs, etc., both prior and subsequent to 1921, is illustrated in Fig. 1. This is a graphic illustration of the results obtained under these two extremes of policy, affected, of course, by the price trend of labor and material in the meantime. The lines plotted represent three general groups, one indicating the growth and size of units maintained, another representing the various unit costs of maintenance and a third representing the frequency of back shop repairs. The growth of property maintained is represented by the dotted line *A*, indicating the total tractive effort pounds owned from 1910 by years to the end of 1924. This growth was not all in the nature of new equipment, but represents power added by the acquisition of subsidiary and leased lines, as well as some new equipment, and to that extent the growth line should not be confused with the rate at which new equipment might have eliminated obsolescence. This very fact has a marked bearing on the cost of maintenance as the total growth consisted of approximately as many of the smaller and older locomotives as the acquisition of the larger and newer types. As to whether or not this extension of property was consistent with the growth of business naturally depends upon how the acquired lines may have increased the amount of business in relation to the amount of property. It is not desired to elaborate here upon the principles of the proper rate of growth of property, but merely to state that the method of computing the proper growth would be to determine the gross revenues per locomotive owned, affected somewhat by the characteristics of the lines added, as to their ability to function on a high or low unit train tonnage basis. Nevertheless, the growth of property represents a serious problem in the matter of having back shop development keep pace therewith and of getting continuous use from power.

Fig. 1 also shows (by heavy dot-and-dash line *C*) the increase in the average size of locomotive expressed by the mean tractive effort pounds per locomotive owned. The size of locomotives is an element in the unit cost of maintenance and it will be noted that this figure increased from approximately 24,000 tractive effort pounds per unit to 36,000 pounds in 1924 or approximately 50 per cent. The chart is confined to steam locomotives only, electric locomotives being a separate and distinct problem. It is not possible to state whether the growth in locomotive ownership increased more or less than the revenues or the average train load as this data is not available from the subsidiary and leased lines.

The feature in Fig. 1 deserving of closest study is the line *D*, representing the frequency of back shop repairs. This is arrived at by dividing the total yearly classified repair output into the total owned throughout the year, which expresses the number of years between shoppings thus developed and this, of course, varies from year to year according to the difference in the number of locomotives owned or used and the output. This is based upon a classification of repairs instituted during federal control and is translated back to 1912. It may be generally conceded that this classification is not sufficiently specific to be a complete measure of output, since the divisions are not based on work units to a great enough degree to permit of judging shop output in detail.

Results of low frequency shopping policy

The variation in the trend of line *D* is entirely dependent upon the allotment of labor and materials available for maintaining equipment. The shopping frequency increased gradually from 1912 to 1920, and during the latter year locomotives were going through at the rate of once every 14.28 months. In 1921 a committee was appointed to report upon the economics of shopping power, as a result of which it will be noted there was a radical change in the frequency of back shop classes of repairs subsequent thereto. This study related particularly to the situation existing on the Chicago, Milwaukee & St. Paul and is not offered as a criterion, for the reason that other conditions often determine whether or not such a policy is applicable to any but a specific case. The frequency of shopping trend, expressed both in years and in months between shoppings, was as follows:

Year	Years between shopping	Months between shopping
1920	1.19	14.28
1921	2.20	26.40
1922	3.30	39.60
1923	2.50	30.00
1924	3.70	44.40

The change in plan necessarily brought about some modification in the distribution of machine tools and facilities in back shops and roundhouses. Great care had to be employed to avoid deferred maintenance under such a transition, because of the great cost incident to overcoming deferred maintenance promptly and adequately, were this condition to have obtained. The roundhouses were partially equipped to do the necessary machinery and running repair work and in some cases rather heavy boiler work, so as to properly maintain the power for longer periods, some of the facilities being transferred from the back shops to the roundhouses. The back shop forces were reduced in proportion.

Prior to the change all judgment as to months good for, miles to be run between shoppings, etc., was based on the theory that locomotives were good for a term of 12 months only and, consequently, much data was prepared to show that this attitude was not in keeping with the operation of the property and, therefore, should be adjusted to the new method. Prior to 1921 there was no specific application of the plan of assigned mileage to be used as a basis for shopping power. This method was put into use at that time and a statement prepared showing the expected mileage to be run out after each classified repair, divided according to types of power. It is important that the same mileage should not be applied to the same type of power regardless of where or how used and in this respect an assigned mileage for each class of service, type of power and for each division instead of for the system as a whole is necessary in practice, otherwise classified repairs will be made in roundhouses, but not so reported in order to avoid breaking the mileage.

As to the results obtained from this change of plan, it should be understood that there were some wage and material price variations since 1920, but these adjustments account for approximately 14 per cent of the reductions attained. The cost trends on the chart merely indicate the actual reductions with no separation between fluctuations in the cost of material and labor, shop efficiency, etc. The cost per locomotive mile (line *C*) during the high wage period of 1920 had reached 34 cents, when the shopping frequency was 14.28 months, and since the frequency of back shopping was reduced the cost has steadily declined and in 1924 was less than 26 cents. This represents a reduction of approximately 24 per cent. The cost per tractive effort pound was reduced from 27 cents in 1920 to 16.5 cents in 1924 or 39 per cent. The cost of repairs per locomotive owned was $9,300 in 1920 and $6,000 in 1924, or a reduction of 35 per cent. The cost per thousand tractive effort ton miles was reduced from 1.075 cents in 1920 to .676 cents in 1924 or 37 per cent. In the meantime, the average size of locomotives increased 6 per cent. The method of measuring the cost of repairs per tractive force ton-mile was to take the tractive force pounds owned, reduce them to tons, multiply by the total locomotive miles run in thousands and divide this into the cost of repairs, Account 308.

This principle of shopping locomotives is in no sense special or peculiar. As to whether or not a policy as outlined could be taken as a criterion, it would be difficult to state. The plan was adopted for the C. M. & St. P. because it appeared to be properly applicable. It is a matter of interest, however, to make a study of ten carriers, where there is a wide range of policy, using the same units outlined above. The value of the units used cannot be considered as entirely intrinsic and for that reason the method employed should not be considered as absolute. Fig. 2 is offered as a result of a study of various carriers, some having a high frequency and some a low frequency method. In plotting the data, scales were used merely to throw relative items together in order to indicate those which run in a certain ratio and those which run inversely. The horizontal scale is the average tractive force pounds per locomotive owned to show the size maintained. The data is based on 12 months in 1924.

How size of power affects performance and unit costs

In the matter of performance the average miles per locomotive run per year is shown in line *A*, Fig. 2, and this indicates a difference in performance which does not follow relatively the variation in size of power, indicating many degrees in intensity of use, etc. The mileage

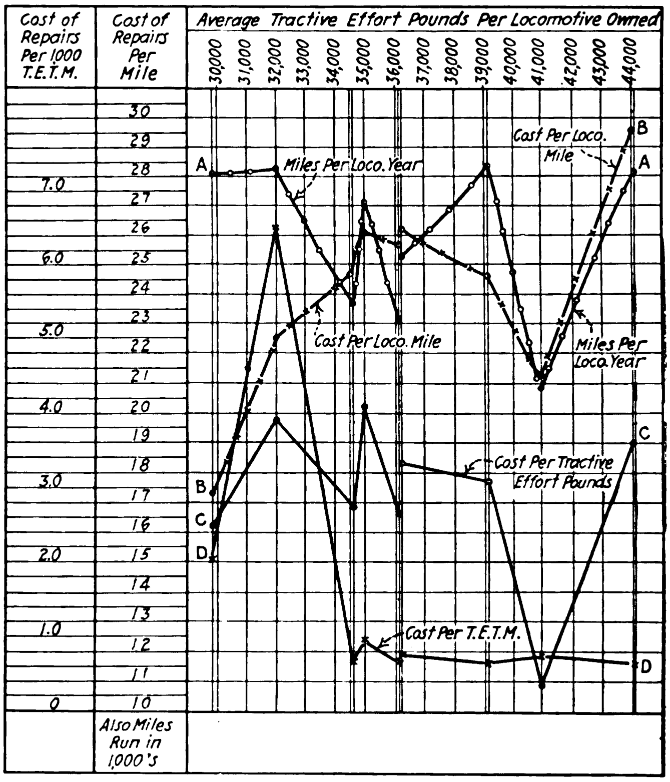


Fig. 2—Comparison of cost of maintaining steam locomotives considering average size, average miles, cost of repairs per mile per tractive force pound, and per 1,000 tractive force ton-miles

ranges from 20,800 to 28,476 per locomotive per year. The carrier with the largest size of power made practically the same mileage per locomotive as the one with the smallest size of power shown on the chart, whereas those administrations with locomotives of a size ranging between the two extremes made less mileage per locomotive. This may be considered an element of performance and demand characteristics of the lines involved. In this case the highest mileage was 37 per cent greater than the lowest shown.

The cost per locomotive miles as shown by line *B* is low for the carrier having the smallest size of power, being less than 17.5 cents and is high for the one having the larger size of power, the upper range being a little less than 30 cents per locomotive mile. The average size of power expressed in tractive force pounds was 47 per cent greater in the largest average size as compared with the smallest average size, whereas, the cost per mile was 71 per cent greater for the larger than the smaller power so that it may be said that in this case the cost increased one and one-half times as the unit size of power in-

creased. This figure itself cannot be considered as entirely significant.

The cost of repairs per tractive force pound does not run in direct ratio with the increase in size. It will be noted that while the smallest size of power has the lowest cost of repairs, the largest size of power does not have the highest cost of repairs, both being exceeded by carriers having locomotives of intermediate capacities. The composite factor of cost of repairs per thousand tractive force ton miles, followed somewhat inversely with the capacity of power owned, with variations in the intermediate sizes. Here it is interesting to note that the smaller size of power cost more than the large power, the result being due, in this case, to the carrier with the larger power running about the same mileage per unit as the carrier with smaller power.

In general, it has been found that carriers using large size of power have a fairly high frequency of back shopping, which is of great interest in this study because it is evidence, for the most part, of intensive use and a more or less uniform power demand. Thus far the frequency has been stated in terms of time only. It is affected very largely by the rapidity with which mileage is run out and, therefore, in a general way, reflects whether carriers are long or short in their power ownership.

This data indicates that as the average tractive force pounds owned increases, the cost of repairs per mile increases in a rather definite way; that the average miles per locomotive run and the average cost of repairs per tractive force pound have the same range characteristics; and that the average cost of repairs per thousand tractive force ton miles varies somewhat inversely with the average tractive force pounds per unit owned, with intermediate fluctuations.

Limitations of the units used

In using tractive force ton miles as a unit of measure, in this case, it should be understood that there is a variable feature in the actual amount of capacity employed as compared with the maximum available. Maximum or ruling gradients, scheduled tonnage, etc., are factors in determining how near the available capacity is utilized as compared with the maximum at hand and the studies shown here are made only with the intention of indicating that, regardless of any units of measure used, there are local conditions which determine the differences in the showing made. This unit of measure does not include the work performed—that is, the tonnage hauled—which if added would doubtless give trends differing from those shown on the chart. The tonnage hauled is a matter of record in freight performance only, whereas the data thus far considered applies to all classes of power.

Statistics are now available to show the gross ton miles per freight train hour, which is a fair measure of locomotive performance when considering the average size as well as the number of units employed. This reflects efficiency in train handling as well as corresponding utilization of power and where there is prompt turning in roundhouse care and running repairs fewer locomotives may be used for a given traffic and thus build up a reserve and maintain a proper shopping period. It is necessary, of course, to apply such data to road engines only and this can be done with the information at hand. The variation among carriers in such performance is quite extreme, some having as high as 26,000 and others as low as 12,000 gross ton miles per train hour. This difference is far greater than the average size of power and other influencing factors, such as grades, curvatures, signal stops, etc. This leaves open to study the question of greater development along the line of utilization of power and consequent shopping methods.

Relation between running and classified repairs is significant

Just what effect the specific policy followed has on the trend of the cost of repairs is not thoroughly ascertainable, but it would seem that a minimum cost may be expected when it has been definitely established that a proper balance between classified and running repairs has been arrived at. No specific formula for reaching this division has yet been developed. A study of the cost of repairs per mile divided between running and classified work does not present a solution, because whenever it is necessary to decrease or increase forces and expenses, the fluctuation is felt directly in the back shop and only indirectly in the roundhouse. There is no argument against the great need of having uniform forces and avoiding the closing of shops, because excessive fluctuations in forces cause repair programs and the continuity of work to be disrupted, besides it destroys discipline. Shop output is, generally speaking, directly affected by fluctuations and expenses and this seriously affects the frequency of classified repairs.

Our experience has developed the fact that the application of the assigned mileage for each type of power, regardless of its use, is not sufficiently specific and such process, when employed, needs revising by developing an assigned mileage for each type of power and for each division, so that the local characteristics as to track, curvature, gradients, service, consequent tire and lateral wear, and boiler repairs, can be considered as factors. Theoretically, it is possible to group repairs into time cycles, but time is only one of the elements of shopping power. As the frictional wear is mostly overcome in roundhouses the time element for shopping power resolves itself very largely into cycles based on necessity for heavy boiler repairs.

Factors used in fixing assigned mileage

The factors used on the St. Paul in the general plan of shopping are assigned mileage, time, and actual physical condition based on frequent inspections. Where there is a low rate of run-out mileage, time enters into the calculation to a greater degree than where mileage is run out rapidly. It can be arranged to set a limit of expenditures for the various types of power according to the class of repairs to be given, any over-expenditure to be reported and explained, so that extraordinary repairs may be a matter of record.

The regulation of frequency of repairs to locomotive parts is a matter of long range study and the cycling of repairs cannot be followed specifically in all cases, although it has been our general policy to endeavor to follow a Class 3 repair with a Class 4 or Class 5, then another Class 4 or Class 5 and then a Class 3; in other words, having two minor repairs between two major repairs. This depends on the nature of service performed and the severity as well as the rapidity with which mileage is run out. It cannot at the outset be presumed that we can obtain approximately 50 per cent of the mileage between classified repairs for the first Class 3 repairs and then 25 per cent for each of the minor repairs, as experience has developed that tire and lateral wear develop and become due for renewal just as soon after a Class 3 as after a Class 4 or 5 repair. It is well to contemplate a distribution of the mileage making it equal for each class of repairs, but regulate the cost of each shopping accordingly.

A study of shop and roundhouse facilities cannot be

summarized in terms of specific units, so as to outline the direct effect upon policy and the results thereof. It involves the number of roundhouses per mile of track, the frequency of turning locomotives or the miles run between turnings, etc. As a matter of interest, during the time the St. Paul was undergoing the change in policy referred to, we also made studies of engine house operation, not only as to repairs made, but as to the cost of turning power, frequency of turning, etc., with results shown below:

Transportation expense not maintained

	1922	1923	1924
Average turnings per month	53,572	59,784	54,911
Average cost per month	$430,492	$384,969	$331,830
Average cost per engine turned	8.30	6.44	6.04
Average cost per engine mile	10.25 cents	8.35 cents	7.68 cents
Average miles run between turnings	78	77	78

No comparison can be made with other carriers in this respect, because it is found that the methods of counting engines turned, the accuracy of distributing charges, the nature of roundhouse facilities, etc., vary too greatly. The above is merely shown to indicate that the trend in other expenses affected by locomotives was downward the same way as indicated in Fig. 1. It is very apparent that the frequency of turning power decreases with the increase in average distance between roundhouses, and that the average miles per engine turned will increase with the spread in distance between roundhouses.

We have not been able to observe any adverse effects on the turning of engines because of decrease in frequency of back shop repairs. It might have been assumed that so low a frequency as was developed in the change of policy would throw too much of a burden upon roundhouses for intermediate repairs and increase the hours of detention.

The formulation of specific policy of back shop attention to power, therefore, must consider a wide scope of performance, embracing amount of property owned in relation to the demand and use thereof, the type and size of power, shop and roundhouse facilities and their relation to each other, road conditions, rapidity with which mileage is run out and restored, the ability to maintain a minimum but uniform force in back shops throughout the entire year, the ability in addition to increase the rate of repairs in the low peak loading months so as to have a larger supply available for service in high peak months, the range of variation between high and low peak months, etc. Where back shop and roundhouse facilities are modernized by means of machine tools, power plants, handling devices such as cranes, hoists, tractors, manufacturing devices and an adequate store stock, it should be possible to determine closely the final balance between classified and running repairs with its relation to the cost of performance expressed in various units of measure, some of which were outlined above.

Effect of more intensive power utilization

The utilization of power requires careful and detailed study because any variation must, of necessity, have a marked bearing upon shopping policy. In cases where the per cent of power in service is low compared with the total owned it is usually found that the hours of service per day are low or approximately six, then it is possible to have a large waiting list and to turn locomotives less rapidly through the shops and still have ample protection.

A campaign to reduce the number of units in active service to a minimum consistent with traffic handled, based on the average miles per locomotive dispatched or the average miles between locomotive turnings (enginehouse operation) will necessarily avoid the purchase of new equipment for the purpose of increasing the complement because when longer runs are installed and fewer locomotives are used for a given service this naturally builds up a surplus. Intensive service requires a revision of the method of repairs and in some cases calls for a higher standard of repairs than where more locomotives are used in the same service. The objective should be to get more locomotive miles per month out of fewer active locomotives and to get more hours of service per day out of each locomotive, then other factors will naturally increase the gross ton miles per train hour.

Modern tools and facilities save locomotive hours

Where orders are issued to shops for locomotives of a certain character to be made ready for service on short notice, the time factor, as regulating the date of delivery, is often a matter of supreme importance. A study of this question soon brings to light an intricate problem with which supervisors and others in authority have to grapple. One of the outstanding factors is that of the machine tool and material handling equipment, with which is identified the means of producing work rapidly and to the best advantage. Many of the latest machine tools, cranes, tractors, etc., are conspicuous for the facility with which they can be operated, the controls being conveniently placed, thus saving time in setting up and subsequently handling the machine.

Another equally vital point is that of the organization of the work, which must, if time is to be saved, be planned on a definite and progressive system. All these measures are applicable to old as well as the most modern new shops, however, they are likely to lose much of their value unless the workmen themselves co-operate in the avoidance of time wastage. It is only by strict co-operation of everyone concerned, combined with proper shop systems and the use of tools and facilities fully adapted to their purpose will rapid production be assured.

Need of a comprehensive program for future improvement

One point of serious practical importance remains, namely, that the designated mechanical officer should place before his executive a practical and sound analysis of the requirements for the upkeep of motive power, shops, power plants, tool equipment and recommendations for expansion or rehabilitation to reduce existing unit expenses known to be out of keeping with the possibilities for best achievement. In making submissions for proposed expenditures, they may be grouped under items of savings as dealing with: (1) fuel, (2) labor, (3) materials, (4) delay to train movements, and (5) accident or personal injury prevention.

It is regrettable and not a little surprising that in fixing ordinary running expense and upkeep, the budget allowance to be approved by any administration should fail to be based upon the requirements of traffic or operating conditions, complying with a general policy formulated to properly care for conditions in the most effective and economical manner and not altered to fluctuate with current temporary drops in traffic, which are often seasonal. What should be arrived at is a reasonable maintenance standard for the property as a whole. The basis should be gaged from a consideration of the general earning capacity and also upon the kind and class of traffic handled. With this part correctly fixed, slight fluctuations in business should not materially alter the progress with the view toward stability of employment and proper discipline and administration of the work.

The motive power man is only as successful as his

management will let him be. This is one of the reasons why so many able men have left the railroad service for other more productive fields. Every motive power man of wide experience knows what the lack of executive support means, and is also aware of what the hearty support of the management as a whole means toward a comprehensive and successful operation. The best policy on earth avails little if it does not have the support from the top of the organization down to the lowest man of the rank and file.

The foreman and his responsibility

First prize article in the competition recently held by the Railway Mechanical Engineer

By "Bill Brown"

A NUMBER of years ago, while working in a railway shop, I became a member of the city band. It was practicing nightly as it had entered as a contestant in a band tournament to be held shortly in a neighboring city. Practically every one in the small city was interested in having our band win. Several of its members worked in various departments of the shop, although I happened to be the only one in my department. One of the foremen, in conversation with the one to whom I reported, happened to mention that quite a number of the shopmen would be off work on the following Wednesday because of the band going away.

"Well," said my foreman, "none of mine will go!"

"But you have Bill Brown over there," said the other foreman. "He is playing a clarinet and will most likely go."

I saw them talking together but had not the slightest idea what it was about. Suddenly I realized that my boss was rushing over to my machine. Almost out of breath he commenced: "I hear you are going off with the band next Wednesday."

I replied: "Those who are to go have not yet been announced. Only 25 can be entered and we have 30 members."

But before I could get that far, he was waving his finger in my face saying: "Let me tell you young man, if you had gone without first asking my permission, you would never have got back here again."

"Why, Mr. ———, I had no intention of ———"

"That's enough! I want no back talk," said he and walked away. (He sure was making use of his opportunities.)

Later, in another railway shop, I started working for 19 cents an hour as a lathe hand and was promised an increase if my work proved satisfactory. Some months later—the day after pay day—I noticed my foreman paying more attention to my work than usual, going by and looking at me quite frequently. I began to wonder if something was up. He even spoke to me about the form of tool I was using, which I thought quite nice of him, since it gave me an opportunity to air my ideas on lathe tools. Then suddenly he asked if I had found anything the matter with my pay check the day before. I innocently remarked: "Nothing more than usual, for my wife has found some difficulty in making it cover our expenses." Then he opened up and called me the most ungrateful man who had ever worked for him, because he had got me an increase of half a cent an hour and I was not man enough to acknowledge it. Well the truth was that with the broken time we were working, I had not noticed the extra 40 cents and only got in worse trying to explain matters.

He certainly was attempting to fulfill his responsibilities all right. With these two examples before me, I remember making a resolution that if ever I became a foreman, I would never be like either of them.

The new foreman

To be more concrete let us consider the opportunities and responsibilities of a machine shop foreman who has just been appointed. At first, he may find himself under something of a handicap, whether he has been brought in from an outside point and placed among strangers, or promoted to be a foreman of men with whom he has been working for years. In either case he may naturally have to contend with a certain amount of what I may call quite reasonable envy, not necessarily malicious. There is bound to be one or more among those not chosen who could reasonably expect to have been promoted instead.

I would suggest, therefore, that when he is promoted he call his men together and say something like this: "Now, fellows, without any influence being used or any extraordinary efforts on my part, I have been given this position. I expect to make a success of it, but must have your hearty co-operation. Whatever opinions we may have formed of each other in the past are buried. We are starting off with a clean sheet. I do not want any one of you to be more square with me than I am with you. I want our relationship to be one of mutual helpfulness and pleasure, consistent with making it the success expected of us by our company. I shall want things done my way because I will be held responsible, but you will find me ready at all times to discuss your way and adopt it if you can show that it is the better way. Because I am the foreman, it does not follow that I know more about everything in this department than you men and the one making a good suggestion will be given the fullest credit."

Having thus started his career, our foreman should ask himself at the end of each day just how far he has fallen short of his responsibilities and opportunities as outlined for himself at the start; also if any of his men have failed in theirs. He can be as severe with himself as he pleases, as it is his own affair, but how will he handle those of his men who he is sure are not giving their best efforts? They must be studied individually. What could be said to one with good results, would fail utterly with another. Of course, I am assuming that the foreman wishes to keep his men and get them working with him and not to make use of his authority to let them go. That should be done only as a last resort.

Keep posted about railway affairs

He should try to acquaint himself with his men's point of view of things in general; and be ever ready to explain,

if asked, such workings of railway management as he is capable of, why short hours are sometimes necessary, the operating ratios, fuel saving, taxation, rates, etc. To become fairly well posted on these subjects, it is not necessary to devote more than one-half hour each evening to the columns of *Railway Mechanical Engineer* and the Railway Age. In fact, to keep in touch with the latest railway shop practices and the workings of the other important departments, it is essential that he be at least a casual reader of these journals. The more he studies them, the more he will realize what his responsibilities and opportunities really are. The advertising columns alone are an education.

Treatment of new employees

The new man you take on is just as anxious to make good as you are to have him. The foreman's responsibilities and opportunities in this respect are very pronounced. If the new man is taken to his machine, given a job and a blue print and told to get busy, he may possibly succeed in giving a good account of himself. If, on the other hand, he is told, in a friendly manner, a few things about the shop, its methods, number of men employed, just how to obtain tools from the tool room, who to ask for information he may need, and that he is not expected to make a record the first day but to accustom himself to his surroundings first, and then go ahead, it will make a great difference. If you happened to notice when you hired him that he wore a fraternal pin, if he is an entire stranger it might be well to say to Bill Jones (if Bill also wears a similar pin on his best clothes): "Say, Bill, you might take a little interest in that fellow for a few days. He is a stranger in the shop. I believe he will make good as he has been well recommended and we will give him every chance."

Of course the foreman should first be reasonably sure that the man has the ability required. It is not necessary to hold every man who starts, but the greater number who are held, the less the labor turnover and consequently the greater ultimate shop efficiency.

New tools or machinery

The foreman should at all times be familiar with the prices and types of various tools that could be installed to advantage in his shop or department. He should be ever ready, on a few hours' notice, to state definitely just how five, ten or fifty thousand dollars could be economically expended on machinery or devices for improving the production of his department. A close study of the advertising pages of the previously mentioned journals, a few days spent in visiting shops where such machines are in service, or the writing of a few letters to other foremen, are all productive of a wonderful amount of valuable information to be kept ready at hand for just such a time as this. It is most inexcusable for a foreman not to keep himself thoroughly posted on the latest products of the machinery builders which can be profitably installed in his department.

The sales engineer

There are certain shops where the foremen are not permitted to meet any of the sales engineers. Those who are privileged to meet such representatives and discuss new machine tools with them are certainly losing opportunities in making unsound excuses for not doing so. These men as a class are far from being ordinary peddlers. They generally have an interesting story to tell and the writer has often been obliged (gladly) to work extra hours because of having spent some of his time during the day investigating the claims and merits of various machines or devices with which he was unacquainted; and has felt amply repaid for so doing.

The foreman's relationship to the foremen of other departments should be the same as that of each member of a successful baseball team to the others—team work at all times. He should not be delighted to see the other fellow get into a hole but be more than ready to assist him to keep out of one. The opportunities for this display of inter-department team work are so numerous they can not be listed. I am calling attention to them because there is an altogether insufficient amount of this sort of team play noticeable in many railway shops.

Conservation of material

A great deal has been written about the wonderful work of the reclamation departments, but foremen should realize that before a great deal of this material can be reclaimed or salvaged, it must first pass through his department as scrap. He must see that nothing goes out in the scrap to the reclamation department which is merely sorted out and returned to him to be used again.

Among the most important of his responsibilities should be the systematic gathering and indexing of many useful facts in connection with his department, such as the comparative value and cost of leather and fabricated belting, cost of such standard articles of daily use as monkey wrenches, hammers, taps, hack saws, nuts and bolts, oil for machinery (who is using the most of these things and why), the comparative cost of electric and acetylene welding and cutting processes and the amount saved weekly by their use. These are but a very few of the large number of very ordinary everyday facts foremen are frequently found to be unacquainted with. Lack of space alone prevents one from dwelling at greater length upon such an important subject.

Attitude toward apprentices

Perhaps his greatest responsibility is in his relationship to the apprentice boys under his charge. These boys come to him fresh from the school teacher. Possibly he is the first man they have ever worked for and, at first, perhaps they should be looked upon as one does upon a frisky colt when first being broken to harness. Much of the boy's future success in life depends upon how the foreman handles him during this important formative period of his career.

Even if there is an apprentice instructor devoting his entire time to the boys, or if the boy is turned over to the charge of a gang boss, take time occasionally to stop and ask him how he is getting along, and how he likes his work. Endeavor to start him thinking by asking such questions as will make him investigate things for himself, such as why do you think we superheat locomotives, why do they apply boosters to engines, is the air pump operated by superheated or saturated steam, how do they get water into a boiler, and hundreds of other and varied questions, always having one ready to ask him. Note the pleased smile when your boy at last gives you an accurate reply. Then congratulate him. A pat on the shoulder and a few words of encouragement from his boss from time to time are never forgotten and cost you nothing. Remember too, these boys are always pleased to get your mechanical journals when you are through with them. Mark an especially interesting article occasionally and pass it around among the boys; then discuss it with them later. You will hear some interesting comments.

One of the most pleasant of many experiences with boys was that of recently being surrounded by about twenty bright apprentices and listening to each one try to explain to me the reading of a 24-inch Brown & Sharpe vernier. They had been asked the week before if they could do so and upon replying they could not, were given a week to try to find out. Many went to the public library for in-

formative articles. Others looked up tool catalogues. Altogether it proved to be a very interesting talk and helped impress one with the responsibilities and opportunities of a foreman in this respect.

I cannot close without making some reference to the responsibilities and opportunities in being thoroughly systematic in so routing the work through the shop as to be able at all times to determine what caused a delay to a pre-arranged schedule of production. To be able to say justly: "Thou art the man," is a most important opportunity and until the foreman is able to do exactly that, even if the "man" is himself, he is not living up to his responsibilities.

Many other aspects of the question could be presented at some length, including the responsibilities in connection with those directly superior to him, his opportunities for boosting the worthy men under him and seeing that they are given proper recognition, his relationship to the stores department, his connection with and support of such work as safety first and first aid, and his interest in shop sports, baseball, football and even horseshoe pitching, etc. These are his responsibilities and opportunities.

Santa Fe apprentice instructors meet

The three-day conference at San Bernardino proved to be more than ordinarily successful

THERE are many features which contribute to the splendid results the Santa Fe derives from its system of apprenticeship training. Once each year the apprentice instructors of the system, some three-score-and-ten in number, are assembled under the leadership of F. W. Thomas, supervisor of apprentices, for a three-day convention in which to discuss methods and practices relative to the training and development of apprentices. Besides talking shop with each other and discussing matters directly bearing on the work of the apprentice department, they also have the benefit of the advice and council of many mechanical department officials who attend these conventions and take active part in the deliberations. The instructors also have the opportunity of listening to addresses from system staff officers on subjects relating to their respective departments and to discuss in an informal way with these officials matters in which they are directly interested.

It has been the custom to hold these conventions on a different grand division of the system each year, thus giving the instructors an opportunity to become more familiar with the road as a whole and to observe the equipment and learn of the methods and practices used in different shops. The conventions for the three preceding years were held in turn at Topeka, Kans., Galveston, Tex., and Albuquerque, N. Mex. This year's convention was held at San Bernardino, Calif., April 23-24. Last year the instructors had an opportunity to visit the company's new up-to-date shops at Albuquerque and this year to see the new shops now being erected at San Bernardino.

In order not to take up space desired by the traveling public in regular sleepers, the instructors enroute to and from the convention were carried in two special sleepers, thus giving them an opportunity of mingling with one another, of talking shop, comparing and discussing in an informal way methods and practices in which they are jointly interested. It was interesting to note how the car department instructors, or the boiler maker instructors, or some other group would get together in the Pullman smoker or elsewhere and talk over their special problems. Many of the instructors reported fully as much real help from these informal discussions while enroute to and from the place of meeting and between sessions of the convention as from the convention itself.

This year's convention was reported to be the best ever held, more interest and enthusiasm being shown than ever before. Four supervisors of apprentices of other roads, all former Santa Fe apprentice instructors or graduates, were present and took part in the discussions. H. S. Wall, mechanical superintendent, A. G. Armstrong, superintendent, San Bernardino shops, and all master mechanics of the Coast Lines attended each session, taking an active part in the meeting. Other Coast Line officials and many foremen from the local shops attended certain sessions. The following staff officers addressed the convention: George Austin, general boiler inspector, T. S. Stevens, signal engineer, E. J. McKernan, supervisor of tools, Roy Hunt, fuel supervisor, L. H. Collett, safety supervisor, and E. E. Chapman, engineer of tests. The instructors were welcomed to San Bernardino by the mayor of the city and by the president and the secretary of the Chamber of Commerce, who besides boasting of their city, as only Californians can do, stated that the railway was the backbone of their city, and that the city's welfare was closely linked with and dependent upon the welfare of the railway.

Mr. Wall in his opening address said that two prominent mechanical officials of other roads had told him that when a Santa Fe apprentice graduate asked for work, they always made a place for him; they knew he would be a skilled all-around mechanic. It was an evidence of the thoroughness of the training given apprentices on the Santa Fe that other roads not only come to study the methods used but that several of them had employed apprentice instructors from the Santa Fe to install and conduct apprenticeship systems on their roads. He pointed with pride to the list of 240 apprentice graduates who are now filling official positions on the road, seven of them being division master mechanics. He urged the instructors to renew their efforts to leave nothing undone that would make the apprentices better mechanics and better citizens.

The following outline of a few of the subjects discussed will be of interest and reflect the thoroughness of the methods used by the Santa Fe in the training of apprentices.

Boiler maker apprentices

The discussion relative to boiler maker apprentices embraced three features of boiler maker apprenticeship—Federal rules, autogenous welding, and the Locomotive Folio. Each boiler maker apprentice is provided with a copy of the company and Federal rules on maintenance of boilers and appurtenances thereto and is required to study these rules. At stated periods in the school course he is required to answer in writing certain questions. He

first roughs out the answers on a scratch pad, then submits them to the shop instructor who ascertains if he has a clear understanding of the rules covered. The apprentice then, as a part of his school course, neatly prints out the answers. The shop instructor also quizzes him while he is actively engaged in boiler work in the shop to see that he knows and understands the rules pertaining to the work on which he is engaged.

The discussion as to welding covered the amount of welding experience to be given each boiler maker apprentice, the use of the welding folio, the value of requiring the apprentices to make test welds and thereby prove their ability to do good welding, and how to provide sufficient experience for apprentices at points where opportunities are limited.

The Locomotive Folio is a book of standard practices for the system. The apprentices are made familiar with and taught to obey its instructions. The rules in the folio are taught in much the same manner as the Federal rules. At the close of the discussion of the subjects pertaining to boiler maker apprentices and after the address by George Austin, general boiler inspector, the boiler maker apprentice instructors went into conference with Mr. Austin, and discussed various features of boilers and boiler work.

Car department apprentices

Considerable time of the convention was devoted to the discussion of carmen apprentices, the schedules of shop work assigned carman apprentices, the portion of time to be devoted to steel and to body work, the relative value of the different classes of work in the coach shop and cabinet shop, the importance of all freight carman apprentices having a thorough knowledge of A. R. A. Rules, and methods of teaching these rules. It was the general opinion that the carman apprentices now in service were doing exceptionally well and that as they were graduated the road would be supplied with carmen of much greater than the average ability and training. C. N. Swanson, formerly superintendent of the Topeka car shops, was present and took part in the discussions.

School room schedules

Schedules have been adopted showing the time allotted for each series of lessons assigned the apprentices in the school room. These schedules have been effective in increasing the amount of school work completed. Each apprentice is advised of his standing and at most places the record of all apprentices is posted on a bulletin in the school room, thus creating a friendly rivalry and inspiring each to maximum effort. Moreover the supervisor of apprentices is given a monthly report showing how much each apprentice is ahead or behind the prescribed schedule. Some instructors were asked to tell why so many of their apprentices were behind the schedule, others why their apprentices easily made the schedule. In this way many valuable suggestions were received, and conditions pointed out that will be corrected.

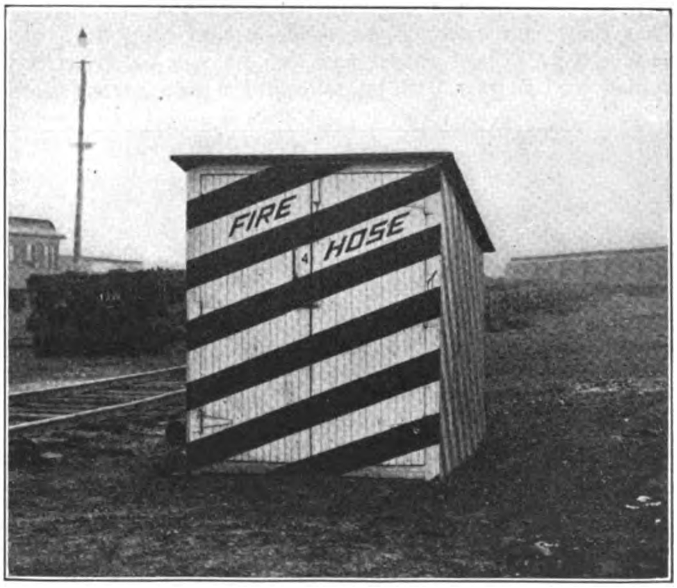
Apprentice clubs

During the past two years, apprentice clubs have been organized at practically all division points on the system. Two system apprentice conventions have been held, one at Albuquerque a year ago and one at San Bernardino the past year. These and the conferences of railroad boys conducted by the R. R. Y. M. C. A. at St. Louis and Detroit have created great interest and enthusiasm among the apprentices and have proved of much help in the development of the apprentice clubs. Through these clubs the morale of the boys has been raised. They are taking greater interest in their work and in the affairs of the community. The purpose of the clubs is to give the apprentices an opportunity for clean sport, a social good time, an opportunity to lead and direct meetings, to bring apprentices and officials and shopmen closer to each other, and to create a greater loyalty toward each other and to the road they serve.

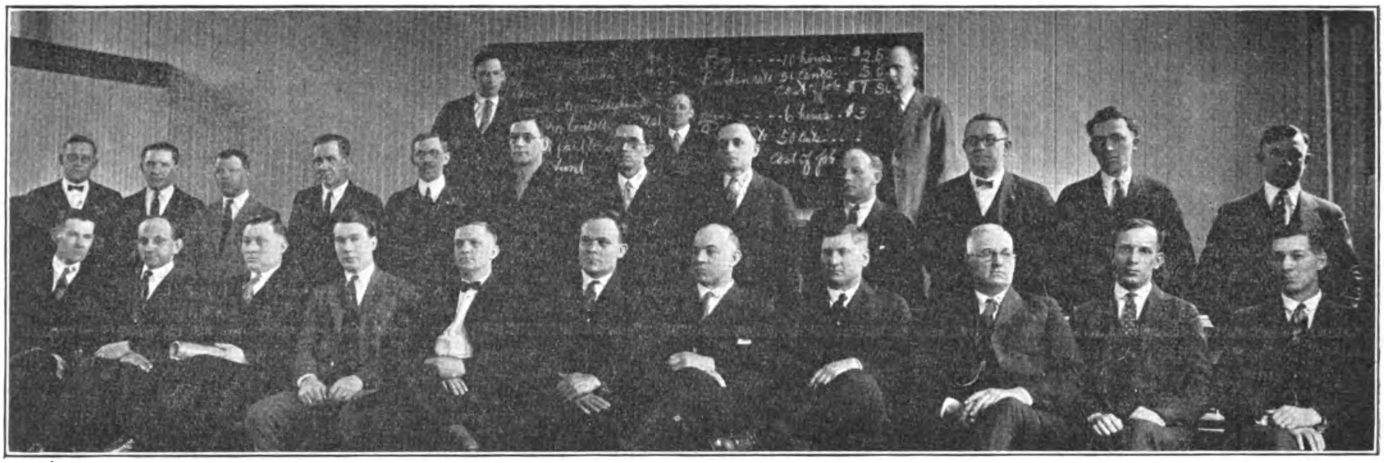
The instructors in reporting the activities of their respective apprentice clubs vied with each other in telling of the good things accomplished. Some clubs had devoted most of their activities to athletics, others had had debates and lectures, others dances and other forms of entertainment, several had put on theatrical events, one club had pulled off a real wild west rodeo, had contributed generously to the rebuilding of a church that had been burned, also to a community hospital, and through a paper of its own had carried on a successful campaign against shipping by truck. From the reports of the activities of the various clubs, the instructors received ideas which will enable them to assist their clubs in making even greater progress during the coming year. It was agreed by all that these clubs and these system apprentice conventions and the national conferences of young men were productive of much good and should receive the hearty support of all who are concerned with the training and development of young men.

There was an exhibit of shop kinks, each instructor having been asked to bring to the convention at least one jig or labor saving device, or a model, print, or photograph of it, gotten up by him or used in his shop, which he thought could be used to advantage at other shops. These proved interesting and helpful.

The addresses by staff officials were most instructive. T. S. Stevens spoke on automatic train control, Roy Hunt told how the shop man could aid in fuel conservation, L. H. Collett, talked on safety, E. J. McKernan talked on tools and shop machinery, congratulating the instructors on their assistance during the past year and showing where further reductions could be made in the expense chargeable to tool account. E. E. Chapman told of the work of the test department and of assistance the instructors could render. All-in-all the convention was a most instructive and inspiring one.



Effective method of marking fire hose stations at the North Billerica shops of the Boston & Maine



Members of the Lehigh Valley foremen's training class at the enginehouse and annex, Seneca Division, Sayre, Pa.

Training foremen in leadership

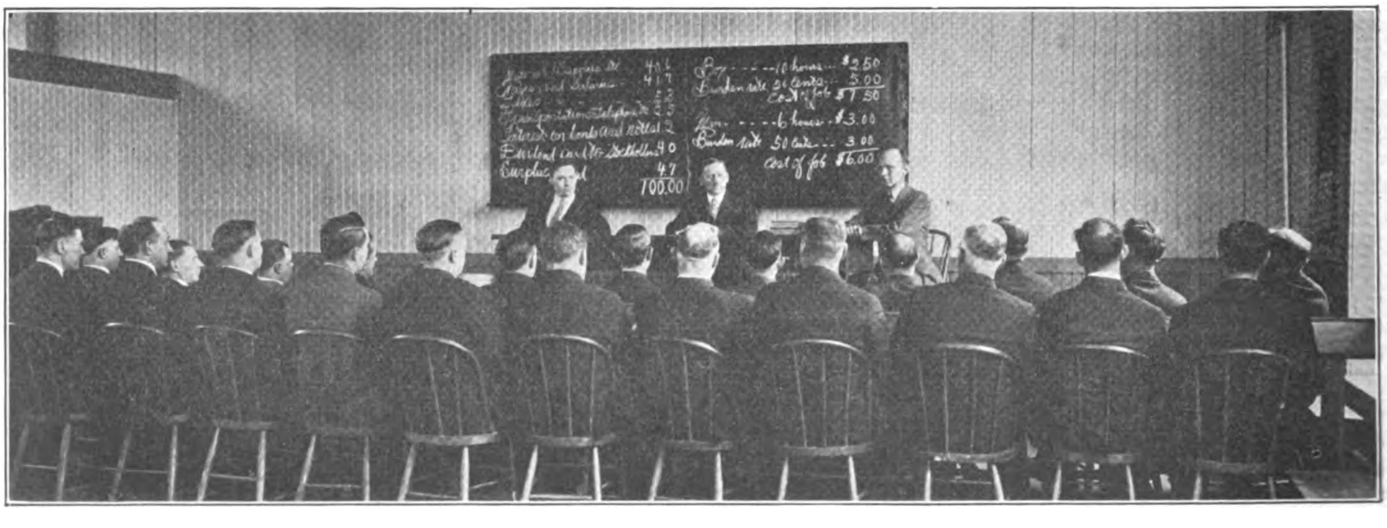
This movement, which started in a small way a few years ago, is now going forward rapidly

THERE has been no more striking development in industry and transportation in recent years than the growing recognition of the importance of leadership ability on the part of the foremen and supervisors. Much stress has in the past been placed upon materials, methods and practices, but too little attention has been paid to the human element. Henry Bruere, a director of the Chicago, Rock Island & Pacific and the third vice-president of the Metropolitan Life Insurance Company, made the statement before a recent meeting of the railway employees' magazines' editors that "the biggest undeveloped asset (on the railroads) is within the ranks."

The foremen and supervisors who come in direct and intimate contact with the men in the ranks carry the responsibility of so leading and directing the workers that they will be developed in a large way to the limit of their capabilities and will co-operate to the utmost. This does not mean that the workers will be forced or driven, but rather that each man will be used on that class of work for which he is best suited and that he will be so wisely directed and helped that he will find a real satisfaction in his work and will utilize his peculiar talents in the most effective way to the mutual advantage of himself and his employer.

Many foremen have recognized their responsibility and opportunities in this direction and have given much thought and study to developing leadership ability. Unfortunately, however, the surface has barely been scratched, so far as the railway field as a whole is concerned. A study of the situation has been made by the *Railway Mechanical Engineer* and the purpose of this article will be to outline the various steps which have been taken by different railroads to train and inspire the foremen and supervisors to become better and stronger leaders. It is significant that in many instances the inspiration or "urge" to take this step has come from the foremen themselves.

Replies from about 100 of the railroad mechanical departments indicate that about one-third of the roads (most of them, however, small in size) are giving no special attention to this question, largely because the size of the organizations is such that the head of the department



Lehigh Valley foremen's training class at the Sayre, Pa., enginehouse and annex in session

can keep in intimate touch with all of the foremen and supervisors under his direction. Of the other two-thirds of the roads, several have developed fairly ambitious plans for the training of foremen, although the greater proportion are confining their efforts in this direction to measures which are far from adequate.

Staff meetings

Staff meetings are quite commonly held, varying all the way from daily meetings at the larger shops for half an hour or so, directly after shop hours, to annual meetings in the nature of a convention. It is only fair to say, however, that in many cases these staff meetings deal almost exclusively with detail problems in connection with material and its handling, shop practices and co-ordination of departmental activities, rather than the problem which most concerns us in this article—a discussion and consideration of those things which will help the foreman to get a better understanding of human nature and of how to develop his leadership ability. It is significant, however, that there is a growing recognition of the importance of placing emphasis upon this question of leadership and that more and more attention is being given to it in the staff meetings.

Of the roads which indicate that they hold such meetings at shop or division points, three state that the meetings are held daily, lasting for a short period, ordinarily not exceeding one-half hour; 18 roads state that weekly staff meetings are held; 23 state that staff meetings are held, but the intervals are not specified. One road, the Chicago, Milwaukee & St. Paul, also holds annual staff meetings, the programs for such meetings being carefully worked up and papers prepared in advance, much as is done by a progressive railroad association.

One road has found that splendid results have followed the holding of weekly staff meetings of the foreman with the group of men who work with him. This provides an opportunity for the foreman to talk to the men as a group and to conduct an open forum discussion, thus promoting better understandings. It was said to be quite evident from observation of these meetings that the foremen needed special training and coaching in the problem of dealing with the men and properly leading them.

Several roads hold bi-weekly or monthly meetings at the shops, at which representatives of the shop employees meet with the foremen to discuss shop conditions in general. Such conferences naturally develop better and more cordial understandings and relationships, as well as constructive suggestions of benefit to both the company and the employees.

Foremen's clubs

A variety of programs have been developed by what may be called foremen's clubs, or which in some cases are designated as mechanical supervisors' associations. Readers of the *Railway Mechanical Engineer* will recall the article on "A Comprehensive Plan for Executives' Clubs", by Simeon van T. Jester in the issue of February, 1924, page 79. The foremen's clubs on the Pennsylvania Railroad were described in an address by I. U. Kershner at the meeting of the New York Railroad Club on May 18, 1923; an abstract of this address was published in the Railway Age of May 26, 1923, page 1259.

The clubs as they were first organized on the Pennsylvania Railroad and the Reading usually held seven or eight meetings during the season at intervals of about two weeks. About an hour was allotted for an address, after which the members separated into small discussion groups, spending another hour in open forum discussion, considering the application of the principles which were developed in the address to the specific departments or responsibilities of the men in the group. The successful handling of these group discussions made it necessary for the leaders to get together in advance of the meeting to talk over the points it would be desirable to develop for discussion. Some of the clubs have done away with the discussion period and are now scheduling only an address. The Reading clubs and the Harrisburg club on the Pennsylvania, however, continue to follow the original practice. The Harrisburg club publishes a bound volume each year, containing a report of the addresses and the findings or high points which were brought out in the different group discussions.

During the past year there were nine clubs in the Eastern Region of the Pennsylvania Railroad, including Altoona, Baltimore, Harrisburg, New York, Philadelphia, Renovo, Sunbury, Trenton and Wilmington. The members of these clubs pay annual dues. In most cases the high school is available for the meetings and there is little expense in connection with carrying on the work of the clubs, except for the cost of the speakers. The company shares the expense with the clubs. The end of the season for the Pennsylvania clubs was characterized by a joint meeting of the Baltimore, New York, Philadelphia, Trenton and Wilmington clubs at the Bellevue-Stratford Hotel, Philadelphia, on March 11, an address being made by Samuel M. Vauclain, president of the Baldwin Locomotive Works. A similar get-together meeting of the Altoona, Harrisburg, Renovo and Sunbury clubs was held in the Chestnut Street Auditorium at Harrisburg, Pa., on March 21, Roy V. Wright, editor of the *Railway Mechanical Engineer,* making the address.

The Pennsylvania clubs include in their membership foremen and supervisors from all departments. There is thus not the temptation to deal with detail shop methods and practices or details of operation. The subjects are naturally concerned with the larger problems of management in its various aspects. The program of the Pennsylvania clubs, for instance, included three addresses by Dr. A. F. Sheldon, one on "Principles of Service", another on "Psychology of Human Relations", and a third, "Universal Efficiency Formula". Doctor Sheldon characterized this group of lectures as a part of the science of human engineering, which he called the science and art of man-power development. The other addresses on the Pennsylvania clubs' programs differed more or less from each other. In addition to Doctor Sheldon's addresses at Harrisburg, Superintendent William Elmer made an address on "Maintenance Versus Renewals"; E. E. Griest on "The Foreman as a Business Getter"; Superintendent of Motive Power E. B. DeVilbiss, "Legislation Affecting Railroad Operation"; and John A. Oartel on "The Foreman and Safety First". In contrast to this the Altoona club, in addition to the three addresses by Doctor Sheldon, had one by Dr. A. B. Van Ormer on "Co-operation Among Railroad Employees"; one by W. D. Henderson on "Human Nature and the Changing Order"; and one by Charles Woodward on "Supervision from the Human Standpoint".

Reading Company clubs

Three foremen's clubs open to supervisors from all departments were organized on the Reading in May and June, 1923. The Philadelphia club has a membership of about 430, Reading about 395, and Shamokin about 150. The arrangement of the programs has already been referred to. During the first year the clubs held ten educational meetings and a banquet. During the past season they have held eight educational meetings, one outing and two banquets.

Boston & Maine clubs

Last year four foremen's associations were organized

in the mechanical department on the Boston & Maine. Monthly meetings were held by the members of these clubs on their own time and expense, for the purpose of discussing questions of supervision and efficient shop practice. The railroad management co-operates to the extent of furnishing speakers and, where necessary, meeting places. These four associations or clubs functioned so greatly to the satisfaction of the members that four additional clubs were formed during the past year, making eight in all. The location of the clubs with the membership is shown in the following table. These clubs have held an average of six meetings each during the past season.

Concord Car and Locomotive Foremen's Assn.	65
Billerica and Terminal Junction Locomotive Foremen's Assn.	90
Billerica and Terminal Junction Car Foremen's Assn.	90
East Fitchburg and W. N. & P. Car and Loco. Foremen's Assn.	75
East Deerfield Car and Locomotive Foremen's Assn.	60
Mechanicville-Troy-Rotterdam Car and Loco. Foremen's Assn.	45
Lyndonville-White Mountain Car and Locomotive Foremen's Assn.	50
Springfield Car and Locomotive Foremen's Assn.	30
	505

The tendency, since these clubs are made up entirely of mechanical department foremen and supervisors, has been to go more into the details of mechanical department operations, although the importance of developing a higher quality of leadership has not been entirely lost sight of. Moreover, it is only fair to say that the discussion of the detail mechanical problems has been a large factor in bringing about better understandings between the different foremen and departments and in helping to standardize the best practices. One of the most productive programs during the season was a discussion of the changes in the 1925 American Railway Association Rules of Interchange. There is no question but what the educational material which was developed by this discussion has been responsible for a very considerable financial saving for the Boston & Maine.

Undoubtedly the work of these clubs will be featured in the future by more consideration of questions affecting the directing and development of the human element in the organization. The clubs have formed an Association of Clubs and an attempt is being made to co-ordinate the programs so that the foremen over the entire system will have the benefit of the discussions and questions which arise at any one of the meetings. The Association of Clubs held a get-together dinner and entertainment at Boston on Saturday, May 9, at which brief addresses were made by several officers of the association, by President Hustis and other officers of the railroad, as well as by Prof. William J. Cunningham, James J. Hill Professor of Transportation at Harvard, and Roy V. Wright, editor of the *Railway Mechanical Engineer*.

Other foremen's clubs

The foremen and supervisors on a number of railroads are carrying on activities of a somewhat similar nature.

Central Railroad of New Jersey.—The foremen have recently organized a club at Elizabethport, N. J., taking in the Central division supervisors; and a club at Ashley, Pa., including the Lehigh and Susquehanna division supervisors.

Chicago, Burlington & Quincy.—Supervisor's clubs have been organized and meet regularly at all of the larger points. Foremen prepare papers for discussion on questions pertaining to the handling of men and improved shop practices. Addresses on the art of leadership and other questions of particular interest to the foremen are made by qualified leaders from other fields.

Delaware, Lackawanna & Western.—There is a supervisors' association on this road which holds meetings at least once a month. Officers are frequently asked to make addresses and a monthly leaflet, "The Lackawanna Supervisor", is published under its direction.

Duluth & Iron Range.—A supervisors' club is giving a good account of itself, its purpose being to elevate "the social, moral and intellectual standing of the supervisory force and to cultivate a general spirit of harmony."

Kansas City Southern.—The Mechanical Department Supervisors' Association has a northern division with headquarters at Pittsburg, Kans., and a southern division with headquarters at Shreveport, La. Each group meets once a month and the meetings are alternated in such a way that representatives from one group can find it possible, if their duties permit, to attend a meeting of the neighboring group. Two or three papers are discussed at each meeting. Frequently committees are appointed to follow up some of these subjects and present their findings at a later meeting.

Minneapolis & St. Louis.—A Supervisory Officers' Club has been organized at Marshalltown, Iowa. It holds regular monthly dinner meetings at which papers are presented and topics of interest discussed. It has been a large factor in promoting harmony and co-operation.

Nickel Plate.—A foreman's club is conducted in the local Y. M. C. A. at one of the shops. The programs include addresses on various topics relating to the foremen and their interests, and the railroad.

Northern Pacific.—The foremen at the large shop points have club meetings and other activities in connection with the International Association of Railroad Supervisors and Mechanics. In addition to this, bi-monthly meetings are regularly held at the large shop plants, alternating between safety meetings and staff officers' meetings. The shop crafts representatives attend the safety meetings. Both the staff officers' meetings and the safety meetings are attended by all of the supervisors in the locomotive and car department, as well as representatives from the stores department and the division accountant's office. Ordinarily two papers are presented, prepared by members of the group. This is followed by a general discussion. A report of the meeting, including the papers and the discussions, is furnished to each of the supervisors and copies are also sent to the general officers. It is believed that the preparation of the papers by the foremen and supervisors is helpful in broadening their point of view.

Union Pacific.—Monthly meetings are held by the Mechanical Supervisors' Association, in addition to the staff meetings which are held at the larger shops and division points.

Wabash.—There are supervisors' clubs at Moberly and Decatur, all foremen and supervisory officers in the mechanical and stores departments being eligible. Monthly meetings are held at which technical papers are presented and discussed. Entertainment features are introduced at these meetings and occasionally the meetings take the form of social functions or smokers, with the idea of getting the members and their families better acquainted and promoting a spirit of good fellowship.

Clubs which failed

It is only fair to say that all of the foremen's clubs that have been organized have not made good. We have learned of two such clubs which failed—apparently because they were organized on too ambitious a scale and did not grasp their possibilities in developing leadership ability. But let the brief account which we have received tell its own story:

"The purpose of their organizing was more of a social and educational nature than a railroad business proposition. At ———— the foremen fitted up club rooms which at first were very well patronized by them-

selves and friends. It was not long, however, until interest lagged and this together with the expense entailed soon caused the club room plan to be abandoned. Interest in the meetings they held, which were addressed by different gentlemen on different subjects, also soon diminished and it was not long until we heard no more of the club. No doubt one of the reasons for the loss of interest so soon was the fact that the foremen represented all departments and kinds of work—carpenter, blacksmith, boilermaker, machinist, etc.—and a subject that would be interesting to part of the men would be tiresome and like Greek to the others."

Foremanship classes on the Lehigh Valley

The Lehigh Valley has approached this question of foremanship training in a rather different way from the other roads, although similar practices have been followed in other industries in recent years with excellent results. The foremen enroll in a course on foremanship which has been developed and promoted by the Engineering Extension Division of Pennsylvania State College. The men pay $15 each for the course. The company has co-operated by seeing that adequate facilities are provided for carrying on the class work, and the officers, whenever they have been called upon, have taken a keen interest in participating in the program. Meetings of an hour-and-a-half duration are held once a week. At Sayre, Pa., the foremen at the enginehouse and on the Seneca division form one group and meet in a room adjacent to the enginehouse which has been fitted up for class work of this sort, as well as a social center where the foremen and men may gather at lunch time. This was the first group to form a class of this kind and it has completely covered the course laid out by State College; it is continuing to function as a class and is developing its own topics for study and discussion. A similar and somewhat larger group of foremen and supervisors from the system shops at Sayre hold their meetings in the apprentice school room. There is another group at Easton, Pa.

The first unit of the course is devoted to the responsibilities of the foremen. These are considered in a general way and include a discussion of the characteristics of a successful foreman. The second unit considers aids in production and includes a discussion of those things which have both a direct and indirect influence on production. The third unit discusses costs and their relation to the foreman. The fourth, the foreman's relation to employment; among other things it considers the selection and following up of the worker, a discussion of the cost of turnover, methods for reducing it, etc. The fifth unit is devoted largely to a consideration of safety and the foreman's relation to it. The units following this include other important phases of the problem of leadership and production and also a brief review of the history of industry.

The members of the class first read one of the study units. A member of the class or an officer or representative of State College may then give a talk, discussing the application of the principles from his point of view. This is followed by an open forum discussion, which frequently is carried over to include the class period of the following week. After the study unit has been thoroughly discussed the men answer certain questions in writing and send them to State College, where they are corrected and graded.

The Lehigh Valley people are enthusiastic over the results which have been obtained. The advantages of definitely organizing the study work are obvious. The thinking of the men is directed along a specified program, which has been found to meet the needs of the foremen and supervisors in industry generally. The important principles are discussed in logical sequence. It is true that the Pennsylvania State College course was not specially devised for railroad supervisors. It was developed and outlined after conferences with men from industrial organizations throughout the state and has been very carefully checked up in the industries. The principles of successful leadership are the same on the railroads as in the industries, but there would be certain advantages in considering these principles more particularly from the railroad mechanical department point of view. This would lead to the emphasis of certain parts of the course, while other parts would be given less attention.

The foremen at the system shops of the Lehigh Valley at Sayre, Pa., hold their classes in the apprentice school room

A pertinent suggestion

Unfortunately the programs of most of the foremen's clubs or supervisors' associations are made up of subjects or topics which are not as closely related or co-ordinated as they might be, or are not presented in a logical sequence. Too frequently also the programs are largely in-

spirational in character and no organized attempt is made to follow them up. Study classes have a considerable advantage from this point of view.

One superintendent of motive power who was greatly impressed by this feature and by the fact that more must be done to cultivate and develop real leadership ability, makes this suggestion: During certain times of the year the shop hours are reduced and in many cases the men do not report for work on Saturday. The foremen, however, are expected to report and to plan and discuss the work of the coming week. The suggestion is that the foremen hold a staff meeting at such times, giving whatever attention is needed to the routine problems, and then setting aside a definite part of the time for classes conducted along much the same lines as those on the Lehigh Valley. This suggestion would appear to have great possibilities and its working out will be watched with much interest.

On the Burlington

At one point on the Chicago, Burlington & Quincy a night school class for the supervisors is directed by a representative from a nearby college. The course of study includes plant operation, supervision and other matters of special interest to the foremen and supervisors.

Visits to other shops

Several roads have adopted the practice, when work is light, of having the foremen and supervisors visit other shops on their own system or on other roads. The result is said to have a broadening and inspiring effect on the foremen. Visits made to other shops on the same road help to bring about and promote standard practices, as well as better understandings. Visits to shops on other roads often develop new points of view and frequently result in changing or reorganizing the handling of the work.

When foremen are sent to make such visits it is sometimes well to indicate specifically that they are to look for those things in which their neighbors excel. Nothing is gained if the foreman comes back with nothing new, but with a lot of satisfaction in telling how he is doing things better than the foreman at the shop which he visited.

Technical magazines

Several mechanical department superintendents report that they either furnish the foremen or encourage them to take and study technical magazines. In some cases the foreman's attention is specifically directed to articles in the magazines, and he is asked to give in writing his opinion of the value of the practice or device which is described, and indicate whether it can be introduced in his department to advantage.

Papers such as the *Railway Mechanical Engineer* are clearing houses for the best methods and practices. The value of systematically reading and studying them is commented upon in the first prize article in the contest on the Opportunities and Responsibilities of the Foreman, which appears elsewhere in this issue.

Books

The number of books dealing with problems of leadership and management has been steadily increasing in recent years. These books cover all phases of the broad problem of management and personnel administration. It is surprising how little they are known or read by railroad foremen and officers. Two or three roads have furnished their foremen and supervisors with copies of "Spark Plugs" by Sherman Rogers. This is a small book, easily read and inspirational in character. Between it and "Personnel Administration" by Tead and Metcalf, there is a broad area. The latter book is a standard work on personnel administration, going into all phases of the question in detail.

Thus far but one book has appeared which is related definitely and entirely to the railroad field. That is "Personnel Management on the Railroads" prepared by the Policyholders' Service Bureau of the Metropolitan Life Insurance Company and published by the Simmons-Boardman Publishing Company. It has only recently been published. It does not go into the details or principles of leadership, but does outline what the progressive railroads are doing in different ways to improve the standard of efficiency of management and bring about better relations and teamwork.

R. E. Woodruff, superintendent of the Erie, in speaking at the May meeting of the New York Railroad Club, made this significant statement: "Our men do not know how to oil the human machines properly and, worse yet, they are not aware of it. A check of one organization developed that only 14 per cent of the officers of all grades had actually read or were reading anything that would help them improve their knowledge of human relations. Forty per cent read only technical magazines and papers; 46 per cent admitted that they read nothing but daily newspapers. Some of these men did not appreciate that they were standing still—each was ambitious for promotion but was not studying to qualify for advancement. * * * * Many of these men did not appreciate that there was anything to be gained from reading or studying. They did not know that there were any books on the question of salesmanship or of securing co-operation."

Bulletins

It is the practice on the Delaware, Lackawanna & Western to hold weekly meetings of all shop and enginehouse supervisors and also to issue semi-weekly bulletins to the supervisors. These contain comprehensive information about conditions and include discussions of such things as the human equation, the proper method of planning, costs, shop schedules, etc. These bulletins have been found to broaden the perspective of the supervisors and to give them a better idea of the railroad as a whole and the way in which the different departments can work together to the best advantage.

Study courses

Many of the roads encourage the foremen and more ambitious men to enroll in the correspondence schools or to take special study courses which may prove helpful to them. Several of these schools have courses on foremanship. The Railway Educational Bureau at Omaha has prepared a course of study particularly directed to the needs of the supervisors on the railroads; it was only recently completed, but has attracted favorable attention on several roads.

The course includes a study unit or instruction paper on personal considerations, which includes the following points: The responsibility placed upon the supervisor by his position and title, the desirable ends to be accomplished by the supervisor in carrying out his duties, the supervisor's attitude of mind toward his work, the supervisor's attitude of mind toward his men, the desirability of training one or more understudies, and the supervisor's duty to himself as regards preparation for his own further promotion.

Following this is a unit on the man problem. Attention is also given to the Americanization question in a unit entitled, "The Melting Pot," which is supplemented by a special unit which includes the Declaration of Independence and the Constitution of the United States. Then

follow units on methods of creating co-operative efficiency in railway work, the handling of the present forces, a series of studies on discipline covering the Brown system, the handling of minor offenses and the handling of major and dischargeable offenses. This is followed by a unit on the employment and handling of new men and two units on money values, including one on costs and values and the other on the budgeting of expenses. One unit which has been specially devised to inspire or stir up the student is entitled, "Seeing, Hearing, Thinking." Then come several instruction papers covering the general considerations for planning and scheduling work, on routing work, dispatching work, standards and standard practice instructions, and records. The series as now outlined closes with units on additional personal considerations, promotions and day-by-day supervision.

The Railway Educational Bureau does not require written tests, but the material is so arranged as to encourage the student to think and study along the right lines, the Bureau agreeing to answer any questions that he may ask for further help or information. A question which naturally suggests itself is as to whether a discussion group or class at a local point could not follow such a course to advantage.

Special instruction

One road has found it profitable to provide special instructors to visit the various points on the railroad and conduct schools or classes for supervisors in the mechanical department. Special attention is given to such matters as the federal locomotive inspection rules and the Interstate Commerce Commission safety appliance rules. This movement was started because of the large number of new foremen who were taken into the service in 1922. The returns upon the investment have been so large that this special educational work is being continued.

Apprentice training

At least one mechanical department superintendent insists that the training of foremen should begin when the boys start to serve their time as apprentices. The point that this officer wishes to make—and he is not connected with the Santa Fe—is that one of the best things that has been done in training foremen is the remarkable development of apprentice training on the Santa Fe, which has been so frequently commented upon in the RAILWAY MECHANICAL ENGINEER.

An inquiry, inspired by this suggestion, brought forth the information that the Santa Fe apprentice department keeps an "Honor Roll" which contains the names of the young men who have completed their apprenticeship courses in the last 12 or 14 years and have been promoted to official positions. This honor roll shows that 240 apprentices have been promoted to the following positions:

Division master mechanics	7
Division and general foremen	23
Roundhouse foremen	16
Assistant roundhouse and gang foremen	63
Machine and erecting foremen	38
Boiler foremen	18
Car foremen	6
Miscellaneous foremen	7
Miscellaneous positions	16
Apprentice instructors	46
Total	240

Selecting men for promotion

Another mechanical department superintendent indicates that the responsibilities and requirements upon the foreman are so great that we must not only give greater attention to training and coaching them, but must in the future select as foremen, men who have had a reasonably high and broad education.

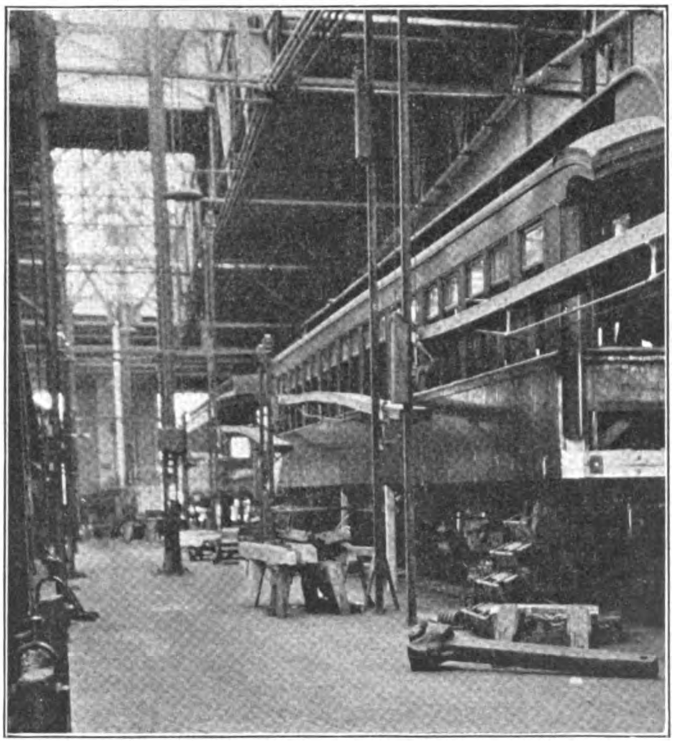
Other mechanical department superintendents place particular stress upon the importance of using the greatest possible care in selecting men for promotion and in seeing that they are carefully coached on dealing with the human element before they are actually placed in charge of a group of men.

General railway clubs

Some of our correspondents have drawn attention to the fact that the railroad clubs throughout the country have given more and more attention in recent years to this question of management and human relations on the railroads. A survey of the topics which have been discussed at the railroad club meetings indicates that one or two of the clubs have been giving an unusual amount of attention to these questions. Apparently this has been appreciated, for these particular clubs have been growing in strength and numbers and the consensus of opinion is that the members appreciate a reasonable amount of this sort of material.

Conclusions

This survey is not intended to be complete or thorough. It is based upon replies to a letter which were received from the greater percentage of the heads of the mechanical departments on the larger railroads of this country and Canada. This has been supplemented by observations by members of the staff of the *Railway Mechanical Engineer*. One thing, however, is clearly evident and that is, that there is a growing recognition of the importance of having the foremen and supervisors secure a better understanding of those principles upon which successful leadership must be based. There are several ways in which this problem can be approached and much progress has already been made on some roads in helping the foremen to improve themselves. The natural result of this has been a better understanding and an improvement of relations between the managements and the workers. It is one of the first steps that must be taken if we are to develop that degree of real teamwork and co-operation which is so much desired.



Interior view of the passenger car repair shop located at the Billerica shops of the Boston & Maine, showing the adjustable scaffolding and wide aisle between the tracks

Master Boiler Makers meet at Chicago

The sixteenth annual meeting of the Master Boiler Makers' Association proves to be one of the most successful in its history

THE sixteenth annual meeting of the Master Boiler Makers' Association opened Tuesday morning, May 19, at the Hotel Sherman, Chicago, with about 700 members, guests and supply men in attendance. President Frank Gray, was in the chair at the opening session.

After the invocation, H. T. Bentley, general superintendent of motive power, Chicago & North Western, addressed the meeting. During his talk he suggested that the name of the asociation might appropriately be changed to Railway Master Boiler Makers," without altering the by-laws or limiting the membership to the railroad field. Practically all members are railroad men and he felt the name should convey this thought.

His suggestions were of a practical nature and dealt with better maintenance, cleaner tubes, the prevention of front end air leaks, and steam leaks—all working for better fuel economy, performance and safety. He also touched on the all important apprenticeship problem. Some incentive must be given young men to enter the railroad trades including boiler making, he said. Foremen and all others should work with the boys and help them in every possible way. When an apprentice completes his course he should be able to handle any and every phase of his trade with facility. He will be able to do this only if his supervisors have worked with him.

The competition between motor truck, bus and railroads received comment. Mr. Bentley said that these vehicles, performing the duties of common carriers, should carry some of the burden of taxation, road maintenance and other items to which the railroads are subjected if they are to be allowed to compete with them. Without such an equalization of tax burden, the motor transport service receives what is in effect a public subsidy and cuts materially into railroad business.

Following Mr. Bentley's address the president delivered his annual address. The remainder of this session was devoted to reports of the secretary and the treasurer and to routine business. Letters were received from A. G. Pack, chief inspector of the Bureau of Locomotive Inspection, and A. R. Ayers, assistant general manager, New York, Chicago & St. Louis, expressing regret at their inability to be present at the convention.

The Wednesday session opened with an address by W. J. Tollerton, general superintendent of motive power, Chicago, Rock Island & Pacific. Economy in operation and maintenance was the keynote of Mr. Tollerton's talk. The executives of the railroads look to the motive power department for the accomplishment of economy in maintenance. To a great extent the members of this association can make savings possible in maintaining in good condition the boilers under their care. Mr. Tollerton also discussed the loss of revenue due to the competition of the motor bus and truck in handling passenger and freight traffic. Following the discussion on this point, he touched on the possibility of fuel saving through the application of thoroughly tested devices such as the thermic syphon, the feedwater heater, the superheater and other appliances. One other matter was emphasized in his talk—the absolute necessity for boiler shops being properly equipped with machine tools so that work may be handled economically and efficiently.

Frank Gray
President

T. F. Powers
1st Vice-President

H. D. Vought
Secretary

W. H. Laughridge
Treasurer

The report of the Recommended Practice and Standards Committee on the subject of "proposed boiler welding practice" was read and each section discussed and acted upon by the convention. As a result of the discussion, the report will be put in final form with such changes and additions as were found necessary to meet the approval of the body. The report in its final form will be acted upon at a later meeting.

The morning and afternoon sessions on Thursday were devoted to the discussion of special topics prepared by committees of the association. The following subjects were included: "Acetylene and electric welding of firebox sheets"; "Flue sheets in combustion chamber boilers"; "Repairing of cracked bridges and cracks in flange knuckles"; "Renewal of staybolts adjacent to those found broken"; "Method of applying arch tubes"; "The train-

ing and developing of boiler inspectors and assistant foremen boiler makers"; "The most reliable water level registering device on a locomotive boiler"; "What is the most economical pump station boiler"; "Boiler corrosion, pitting and grooving."

Officers elected for the coming year

The final session on Friday, May 22, was devoted to routine business. The following officers were elected for the coming year:

President, Thomas F. Powers, assistant general foreman, boiler department, Chicago & Northwestern; first vice-president, J. F. Raps, general boiler inspector, Illinois Central; second vice-president, W. J. Murphy, general foreman boiler maker, Pennsylvania; third vice-president, L. M. Stewart, general boiler inspector, Atlantic Coast Line; fourth vice-president, S. M. Carroll, general master boiler maker, Chesapeake & Ohio; fifth vice-president, George B. Usherwood, supervisor of boilers, New York Central; secretary, Harry D. Vought; treasurer, W. H. Laughridge, general foreman boiler maker, Hocking Valley; executive board, one year, E. J. Reardon, Locomotive Firebox Company; H. J. Raps, general boiler foreman, Illinois Central; L. E. Nicholas, general boiler foreman, Chicago, Indianapolis & Louisville; two years, C. H. Browning, foreman boiler maker, Grand Trunk; L. R. Porter, foreman boiler maker, Soo Line; A. F. Stiglemeier, general boiler shop foreman, New York Central; three years, I. W. Clark, general foreman boiler maker, Nashville, Chattanooga & St. Louis; F. T. Litz, general boiler foreman, Chicago, Milwaukee & St. Paul; C. J. Longacre, foreman boiler maker, Pennsylvania; A. F. Stiglmeier was elected chairman of the board and H. J. Raps, secretary.

Air Brake Association at Los Angeles

Power brake problems are discussed—Address by W. J. Patterson of the Bureau of Safety

THE Air Brake Association held its thirty-second annual convention at the Hotel Alexandria, Los Angeles, Cal., May 26 to 29, inclusive. The association was welcomed by a representative of the city and on behalf of the railroads by W. K. Etter, general manager of the Atchison, Topeka & Santa Fe Coast Lines. Addresses were also made by President C. M. Kidd, air brake inspector of the Virginian, and W. J. Patterson, assistant director Bureau of Safety, Interstate Commerce Commission. Abstracts of these addresses follow:

President Kidd's address

The question was raised of the advisability of holding this convention at such a distant western point as Los Angeles, but our selection of this city is justified by the large attendance. Los Angeles was selected to follow our practice of taking the convention to the different parts of the country to accommodate not only the members of the association, but in order accommodate railroad employees in general.

The character of the Air Brake Association is different from that of any other railroad association. It is purely and wholly an educational institution. The more thoroughly air brake education is disseminated, the better will be the operation of freight and passenger trains and railroad transportation will be correspondingly benefited. Perhaps no separate division of railroad operation carries the same responsibility as the air brake. If one road does not follow recommended practice in the maintenance of triple valves, with standard triple valve test racks, codes of tests, properly adjusted piston travel and properly maintained retaining valves and pipes, and another road does this work, the air brakes will operate at a low efficiency. All must work together in harmony and co-ordination. This can be brought about only by proper education and that is what the Air Brake Association is striving for. It should have the moral and practical support of all railways and railway officers.

Undoubtedly the coming year will bring with it important developments in air brake work. Better conditioning of the equipment and the intricacies of automatic train control will call forth the fullest attention and best efforts of air brake men. We must be ready!

Address by W. J. Patterson of the Bureau of Safety

At the annual convention of this association in 1919, I presented a paper which set forth quite fully the requirements of law and orders of the Interstate Commerce Commission with respect to air brakes, as well as policies and practices of the Bureau of Safety in their administration. At that time I requested this association to co-operate with the government in bringing about general improvements in air brake conditions throughout the country. That is being done, yet still better observance of the rules governing maintenance and conditions of air brakes is necessary for the protection of employees and travelers on our railroads. At that time I said, "I am a very strong advocate of air brake tests on trains when arriving at terminals, and I believe that incoming air brake tests, together with prompt repair of air brake defects, will result in such great improvement in air brake maintenance conditions as to preclude the necessity for more stringent action on the part of the Bureau of Safety than a reasonable interpretation of existing law and the orders of the commission which are in effect at the present time."

What was true at that time is true now and in view of the increasing train length that I then advocated is even more necessary at the present time. Since the date of that meeting there have been several events of outstanding importance affecting the maintenance and use of power brakes. In February, 1922, the Interstate Commerce Commission began an investigation of power brakes and appliances for operating train brake systems, to determine whether and to what extent power brake equipment in common use was adequate and in accordance with the

requirements of safety, what improved devices were available, and what improvements should be made to provide increased safety. The condition of repair of air brake equipment which existed at that time is indicated by results of inspections made by the Bureau of Safety.

In the fiscal year ending June 30, 1922, approximately 1,100,000 cars and locomotives were inspected, on which a total of 55,427 safety appliance defects were found. Approximately half of all these defects, or 27,271, were defective air brakes. In that year inspectors of the Bureau of Safety also tested the brakes on 244 trains upon their arrival at terminals; these trains consisted of 8,898 cars, of which 9 per cent were cut out or had otherwise inoperative air brakes; on 294 cars the brakes were cut out and on 508 cars the brakes were inoperative from other causes.

The number of inoperative brakes in service was altogether too large, indicating a lack of proper attention.

In addition to this altogether too large percentage of defective air brake equipment, the necessity for this general investigation by the commission into the use and operation of power brakes was revealed by representations which were made by certain railroads that freight trains could not be controlled with a proper degree of safety on heavy grades by means of power brakes alone as required by the law. In this investigation, after considerable evidence had been taken and tests conducted, the commission issued a report dated July 18, 1924, and among other things stated that "Improvements in the operation of power brakes for both passenger and freight trains are essential and must be effected." They further stated that "Throughout this proceeding the necessity for better maintenance of present power brake equipment in order to secure proper operation and safely control trains was repeatedly stressed, and this necessity was recognized by both carriers and employees. It is beyond question of argument that piston travel should be maintained within proper limits, triple valves should be kept properly cleaned, brake pipe and brake cylinder leakage should be kept below certain prescribed amounts, and retaining valves with their pipe connections should be kept in good condition; furthermore, rules should provide and proper tests should be made to insure that trains will not leave terminals with defective, inoperative or cut out brakes on any cars."

During the commission's hearings it was noted that no witnesses either for the carriers, the brake manufacturers or the employees testified that power brake systems as a whole were maintained in an efficient or satisfactory oprating condition. On the contrary witness after witness testified that improved performance would result from better maintenance and that such better maintenance should be required.

Following the issuance of this report several conferences were held between representatives of the American Railway Association—who by the way were members of this association—and representatives of the Interstate Commerce Commission, which resulted in an agreement to adopt certain recommendations for maintenance as a measure for carrying into effect the requirements of the commission's report. These rules will be put into effect at an early date and I know that the members of this association will do their part to see that they are religiously observed. The result of their operation will be observed by the commission to determine their effectiveness. Should it be found that these rules, or rules issued in this manner, are not effective to secure the required improvement in air brake maintenance and operation it will become necessary to consider other means and adopt other methods to secure such improvement.

The revised rules establish minimum requirements to which brakes in service must conform, and set forth tests which will disclose whether or not equipment in service meets the prescribed requirements. Each carrier is, however, left free to determine the detail methods and means which it will employ to place and keep the air brake equipment used on its line in the condition required by the rules. Carriers are expected to issue necessary additional rules and instructions, provided, however, that such additions are not inconsistent with the rules which set forth minimum requirements applicable to all carriers.

Another event of great importance in connection with the maintenance and use of air brakes was a decision of the Supreme Court of the United States, handed down April 28, 1924, which construes the associated car provision of the air brake law. In the fiscal year, ending June 30, 1923, inspectors of the Bureau of Safety conducted terminal tests of the brakes on a total of 1,602 trains which were made up and ready for departure. These trains consisted of 50,254 cars, and on 7 per cent of these cars the brakes were cut out or inoperative. On 615 cars the brakes were cut out, and on 2,809 cars the brakes were inoperative from other causes. In the following year some improvement was indicated. A total of 1,504 trains consisting of 50,910 cars were tested; 3.3 per cent of these cars had cut out or inoperative brakes, 296 brakes being cut out and 1,408 being inoperative from other causes. It should be borne in mind that these tests were made after the trains had been made up and inspected by railroad company employees and the trains left the points where the inspections were made in the condition indicated.

In the case decided by the Supreme Court, cars with their brakes cut out were intermingled with operative brakes in the train and hauled from a point where repairs could be made. The court held that the failure of the power brake on a car did not take the car out of the power brake class; that the cars involved in this case were associated with other power brake cars, that the act specifically requires all power brake cars so associated shall have their brakes used and operated; and that cars on which the power brakes have been cut can lawfully be hauled only when placed to the rear of all cars having their power brakes operated by the engineer. For many years the Bureau of Safety has contended that all air brakes on each train should be operative leaving a terminal or other point where repairs could be made. This decision supports that view.

In a meeting of this association, it is entirely unnecessary for me to discuss the question of how to maintain brakes. The records of your previous annual meetings are full of descriptions of such work and suggestions as to what is required to be done. From the standpoint of the Bureau of Safety, in connection with the administration of the law, it is entirely immaterial what detailed methods are employed by the carriers to place and keep air brake equipment in condition to conform to federal requirements. Our only concern is that it shall be done, and that tests are made at sufficiently frequent intervals and repair facilities provided to insure that the air brakes on all cars in trains are in effective operating condition. The distance between points at which inspection, tests and repairs are to be made must be determined separately for each carrier according to their requirements and character of service. The Bureau of Safety will continue to make air brake tests, on both arriving and departing trains, at suitable points to determine the actual condition of brakes on trains operated on each line of railroad.

In improving air brake service on the American railroads, I want to assure you that you have the hearty cooperation and support of the Interstate Commerce Commission.

Big attendance at Fuel Association convention

Many operating and mechanical officers register—L. F. Loree makes the opening address

THE opening session of the seventeenth annual meeting of the International Railway Fuel Association, which was held at the Hotel Sherman, Chicago, May 26 to 29 inclusive, was characterized by an unusually large attendance in which many operating and mechanical officers and supervisors were included, as well as the officers of the fuel departments, traveling engineers and a number of delegations of enginemen and firemen, whose duties bring them directly in contact with the consumption of fuel on the locomotive.

For the first time the program this year has been grouped so that matters primarily of interest to the operating officer were discussed on the second day while those subjects of primary interest to the mechanical department were grouped together on the third day.

L. F. Loree, president, Delaware & Hudson, delivered the principal address at the opening session and his address was followed by that of the president, P. E. Bast, fuel engineer Delaware & Hudson. The program included addresses on the following subjects: How can management effect fuel economy? by A. R. Ayers, assistant general manager, New York, Chicago & St. Louis; How can fuel purchases effect economy? by H. C. Pearce, director purchases and stores, Chesapeake & Ohio, discussion of Fundamental fuel factors, by G. M. Basford, and a discussion of the relation of signals to fuel saving, by B. J. Schwendt, superintendent of signals, New York Central. Abstracts of some of these addresses and a number of important reports will appear in later issues. Following is an abstract of the address by L. F. Loree.

A look into the future

By L. F. Loree
President, Delaware & Hudson

As a lad I read a story of James Watt seated at the fireplace, watching the boiling pot, noting the lid lifted by the expanding steam, and later working out upon this hint his great invention—the steam engine.

The story was, of course, without foundation, and is typical of much purely imaginative matter that is dished up to us. Sometimes I have thought that to no inconsiderable degree the inertia and closed mind of the public is due to the mass of misinformation that is gathered in youth, and the ill result goes even farther, since there is truth in the warning of the Greek philosopher "that we should not lie to the children, if for no other reason than that when they grow up they will not believe even the truth that we tell them."

The first pumping engine

Then, in 1712, Thomas Newcomen, an ironmonger or iron merchant of Dartmouth, England, "fixed the first engine that ever raised any quantity of water, at Wolverhampton." There is still in existence an engraving of it. Looking at this drawing one cannot but be surprised at the maturity to which the engine had been brought and the wonderful achievement that it really was.

John Smeaton, a celebrated civil engineer, turned his attention, about 1765, to the atmospheric engine, and having collected data from some 100 engines, and conducted a series of experiments, set out rules for the best proportion of the parts. The effect of Smeaton's efforts, which were largely reflected in a decreased fuel consumption, is seen in comparing the results he obtained raising 9,450,000 lb. of water one foot high by a consumption of one bushel—84 lb.—of coal, as against the average of the 100 engines he examined, which gave a performance of 5,590,000 lb.

Where James Watt comes in

In 1757 James Watt was in the service of the University of Glasgow, Scotland, living and having a shop within the college walls under the title of "Mathematical Instrument Maker to the University." Here he enjoyed intercourse with professors and students interested in his branch of activities, and here he carried on many experiments with the force of steam.

The University owned a small model of Newcomen's engine, and in the winter of 1763-4 it was given to Watt to be repaired. Watt was surprised and interested by the great amount of steam consumed by the little engine, and set about seriously to investigate the matter.

Early in 1765 the idea occurred to him that the steam, instead of being condensed in the cylinder, might be drawn off into a separate vessel and there condensed. By this means the cylinder might be kept as hot as desired, the condenser as cold as necessary, no steam be wasted and a perfect vacuum obtained. At the time he secured his patent, on January 5, 1769, for "a new method of lessening the consumption of steam and fuel in fire engines," he estimated the saving of steam at one-half.

Watt's purpose was fuel economy

The extent to which Boulton and Watt were dominated by the idea of fuel economy is clearly indicated in the terms they adopted in marketing their engine. They stipulated to receive the value of one-third of the fuel saved by each engine when compared with a common one (not with Smeaton's improved engine) burning the same kind of coal, to be paid annually or half-yearly, with an option of redemption at ten years' purchase. In Cornwall a committee canvassing the situation found that the average duty of the Newcomen engine was 7,037,800 lb. raised one foot high by the consumption of a bushel—84 lb.—of coal. Boulton and Watt's low-pressure engines performed an average duty of about 18,000,000 lb.

The first engines built by Boulton and Watt were atmospheric engines, the open-topped cylinders being surrounded by a steam case, but further economy was found by covering the top of the cylinder and admitting the steam above the piston.

On March 12, 1782, Watt patented his double-acting steam engine, using the expansive force of steam below as well as above the piston, and at once solved the difficulty of applying it successfully to produce a continuous rotative motion.

Little new has been introduced in the mechanism of the engine; in its main features it is today very much as Watt

made it. Watt had mastered the difficulties in the way of employing steam at high pressure; he knew that the steam could be discharged into the open air instead of into a condenser chamber; he was alive to the availability of the expansive force of steam; but he was afraid of the danger attending its use. The materials at his disposal did not command his confidence, nor was there sufficient skill on the part of the engineman.

The commercial success of Watt's invention, designed, as we have seen, to produce an economy in fuel consumption, had been very great; but here the wealth and influence, the energy and tact of Boulton, were invaluable complements to his inventive genius.

A prediction of thirty years ago

Looking to the future, we have to form some conception as to how the coming motive power shall be designed and equipped. There is nothing at the present time that seems promising in electric, Diesel, turbine and various non-reciprocating steam engines. We must continue to fix our attention upon the reciprocating steam-engine locomotive. Here we may discern a number of factors which may be utilized to improve its service and reduce its expense of operation.

In March, 1895, Matthias N. Forney, the author of "The Catechism of the Locomotive," writing as editor in the American Railroad Journal and Engineering Magazine, said:

> Let it be assumed that the fuel consumption on a road is represented by $1,000,000; if 14 per cent was saved by simply testing it and learning which was the best quality to buy, the $1,000,000 would be reduced to $860,000. If, now, we save 10 per cent by an improved valve gear, the million is reduced to $774,000. If feed water heaters should save 14 per cent, then the cost of fuel would be lowered to $665,640; and if superheated steam should fulfill its promise of 30 per cent saving, the fuel account would be brought down to $532,512.

In 1915 the typical large freight locomotive of The Delaware & Hudson was its Class E-5 of the consolidation type, using saturated steam, slide valves and single expansion cylinders, carrying 210 lb. boiler pressure, weighing 227,200 lb. on driving wheels, and rated at 50,600 lb. tractive force. In moving 1,000 actual gross ton-miles, including its own weight, on a 0.5 per cent grade, at average freight train speeds, this locomotive consumed 160 lb. of coal. The first marked improvement was the application of superheaters and the substitution of piston valves for the slide valves, increasing the weight of the engine on the driving wheels to 231,700 lb., and the tractive force to 55,100 lb., and reducing the fuel consumption under like operating conditions to 130 lb. of coal, or by about 19 per cent.

What the "Horatio Allen" has done

Last year we developed a type of consolidation locomotive, changing the E-5 class as little as was necessary, which we named the "Horatio Allen," after the engineer who ran the first locomotive in this country. This locomotive carries 350 lb. boiler pressure, weighs 298,500 lb. on the driving wheels and has developed 75,000 lb. drawbar pull, as measured by the dynamometer. The "Horatio Allen" uses a moderate degree of superheated steam admitted to and exhausted from the multiple expansion cylinders through large valve and port openings. It has a water tube type of firebox with extraordinarily large evaporation surface and a fire brick baffle wall extending the full width and length of the firebox which insures full utilization of the hand fired coal, with long flame travel, securing maximum radiant heat effect and minimum cinder and stack losses. With this engine 1,000 actual gross ton-miles under like conditions require 55 lb of coal.

It is probable that within the year a satisfactory feed water heater will be on the market and that the equipment for burning coal pulverized to about the fineness of talcum powder will be brought into practical use.

Possibilities of the next ten years

Looking over this score of years from 1915 to 1935, and following Mr. Forney's example, the following changes may be anticipated during the next ten years:

Typical steam locomotive coal consumption per 1,000 actual freight train gross ton-miles on equivalent to a 0.5 per cent grade

Year 1915		160 lb.
Reduction in total fuel consumption by means of—		
1. Superheating	to	130 lb.
2. Fire brick baffle wall	to	124 lb.
3. Feed water heating	to	113 lb.
4. 350 lb. boiler pressure	to	96 lb.
5. Improved boiler design, circulation and evaporation	to	84 lb.
6. Multiple expansion cylinders	to	70 lb.
7. Improved steam distribution and reduced cylinder back pressure	to	60 lb.
8. Burning powdered coal in suspension	to	44 lb.
9. Reheating of high pressure exhaust steam in multiple expansion	to	42 lb.
10. Miscellaneous items, such as increased train loading through the use of an auxiliary locomotive, utilizing the dead weight of the tender for tractive purposes, greater sustained boiler horsepower capacity, substitution of poppet valves for piston or slide valves, and higher superheat on account of the use of powdered coal, may bring the final figure down to about		38 lb.

This is somewhat less than one-quarter of the 1915 locomotive fuel consumption. The effect of this would be to reduce the 90,000,000 tons of fuel now used in freight train service to about 27,000,000 tons, effecting a total economy of something like $200,000,000 per annum.

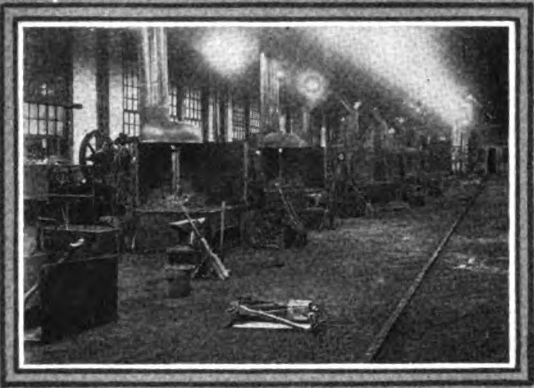
I have had these figures carefully checked with available cost and performance sheets of various railroads, with dynamometer-car road and other tests made by various steam roads, and with laboratory tests made at Purdue University, University of Illinois, and the Pennsylvania, at Altoona, Pa. Discussing them with my own people, they do not seem to me extravagant. There are, of course, debits to be set off, the cost of these appliances and their upkeep, determinable only by experience. But the possible savings are large, and that they will not be confined to those I have listed, no one can doubt.

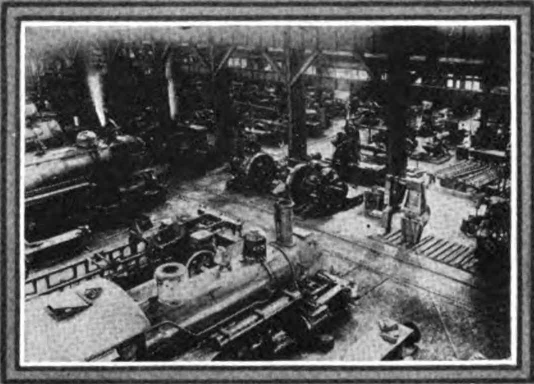
The joy of our occupation is not alone in the service we render but in the knowledge that the industry is alive and vigorous, expanding and improving, exacting from us our utmost effort, inviting every exertion from the dullest of routine duties to the liveliest flights of the imagination. Let us enjoy fully the opportunities it offers, meet adequately its drafts upon us and demand for it the respect it merits from those it serves.

Closing business

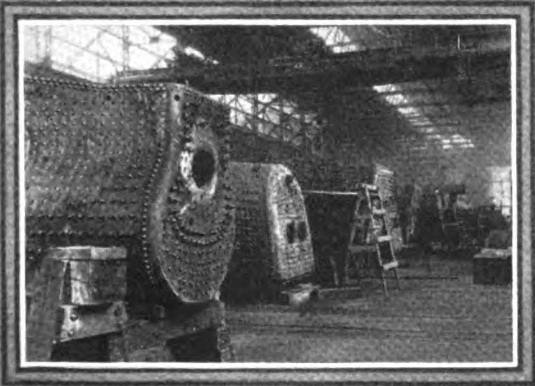
At the closing session of the convention, the following officers were elected for the ensuing year: President, J. W. Dodge, Illinois Central; vice-presidents, E. E. Chapman, Atchison, Topeka & Santa Fe; W. J. Tapp, Denver & Rio Grande Western, and J. E. Davenport, New York Central. The following were elected members of the Executive Committee to serve two years: W. G. Black, New York, Chicago & St. Louis; T. F. Carbery, Missouri Pacific; Carl B. Smith, Boston & Maine; J. J. Stahl, Southern. C. H. Dyson, Baltimore & Ohio, was elected to serve one year.

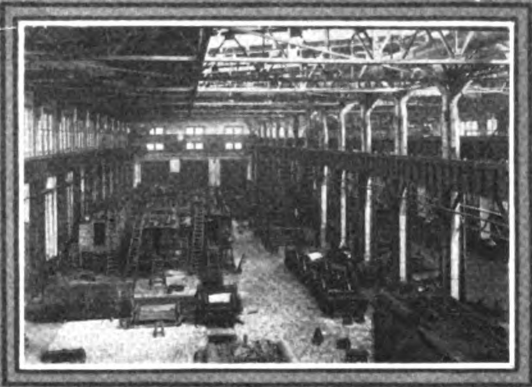
In the ballot taken to indicate the perference of the association for the next meeting place, Chicago received the highest number of votes. Final decision, however, rests with the Executive Committee. The Executive Committee has already announced the tentative dates for next year's convention as May 11 to 14, inclusive, two weeks earlier in the month than this year's convention.





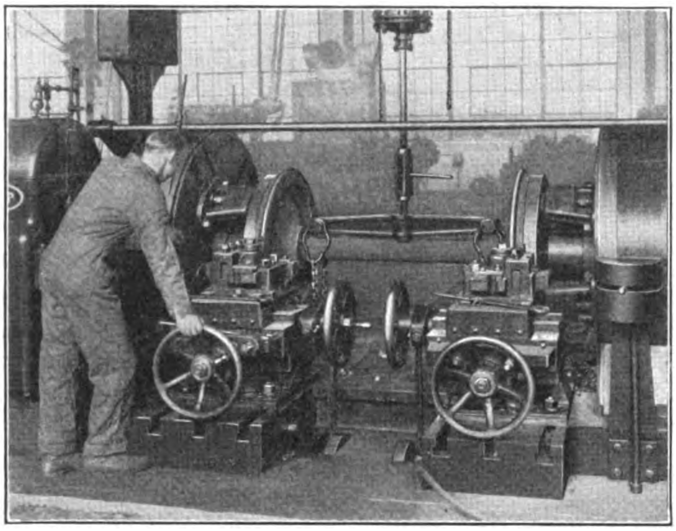
New and Improved Machine Tools and Shop Equipment





Car wheel lathe of the open center type

A HEAVY car wheel lathe of the open center type has been recently placed on the market by the Niles-Bement-Pond Company, New York. It has a capacity to turn wheels, from 26 to 52 in. diameter on the tread, when mounted on axles having either inside or outside journals. In designing this machine special care has been taken to eliminate all unnecessary power losses



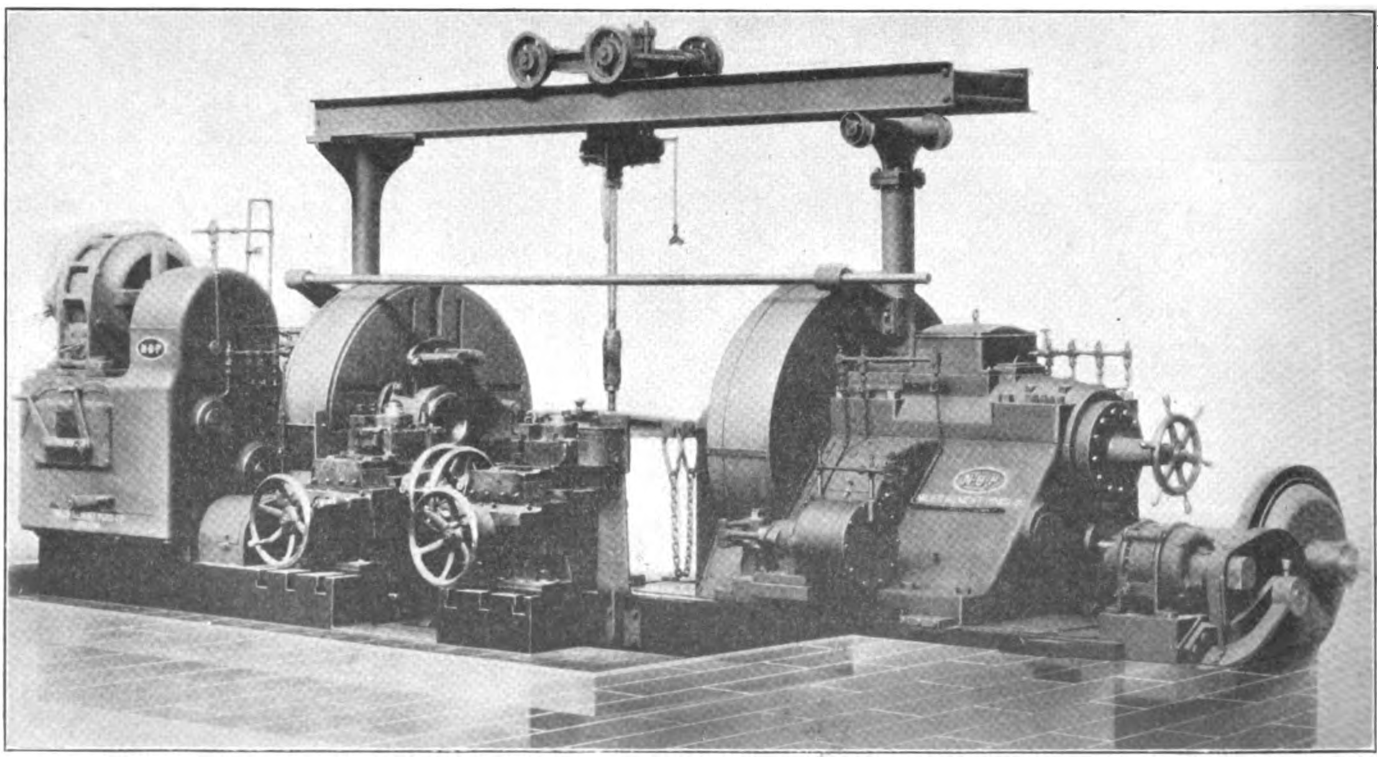
Control levers arranged for the convenience of the operator

so that the maximum power available can be delivered at the tools. The main driving gears have been so arranged that the spindle bearing pressures are greatly reduced—the internal gear face plate drives are claimed to be exceptionally efficient and all heavy end thrusts are taken up by ball bearings.

This lathe is considerably heavier and more powerful than any machine of this type previously built by this company. Its production is limited only by the present day high speed steel used and a reserve capacity capable of taking care of a 50 per cent increase in the quality of tool steel has been built into the machine. The unit system of construction has been adhered to, making all parts very accessible. The most modern and improved time and labor saving devices such as power traverse and clamping to the sliding headstock, semi-automatic driver dogs, wheel hoist, turret tool posts, and automatic lubricating system are included.

The machine is driven by a 50 hp. motor mounted on the drive box with which it forms a self-contained unit. The drive box is totally enclosed, jig drilled and planed so that a speed box of the constant speed or adjustable speed type is interchangeable with the head-stock. All gears are of steel with wide faces and coarse pitch. They are mounted on large diameter shafts which run in bronze bushed bearings of liberal proportions. All overhung gears have been eliminated and each gear is mounted against a shaft bearing.

Both headstocks are of massive construction. The left headstock is stationary and is rigidly bolted to the bed while the right hand headstock is movable and is adjusted to a sliding fit on the bed. It is secured to the bed both front and back by long shoes sliding in large tee slots, the clamping surfaces of which are provided with re-newable steel liners. The face plates, one on each head, are mounted on extra large spindles and are driven in unison by steel internal gears securely bolted to them. The driving pinions are forged steel and are mounted on an auxiliary shaft located at the front of the machine about on a line with the tools. This construction de-creases the torsional strains on the drive shaft and tends to counteract cutting strains, thus reducing the pressure on the main spindle bearings. A large self-alining ball thrust bearing takes the end thrust of each spindle.

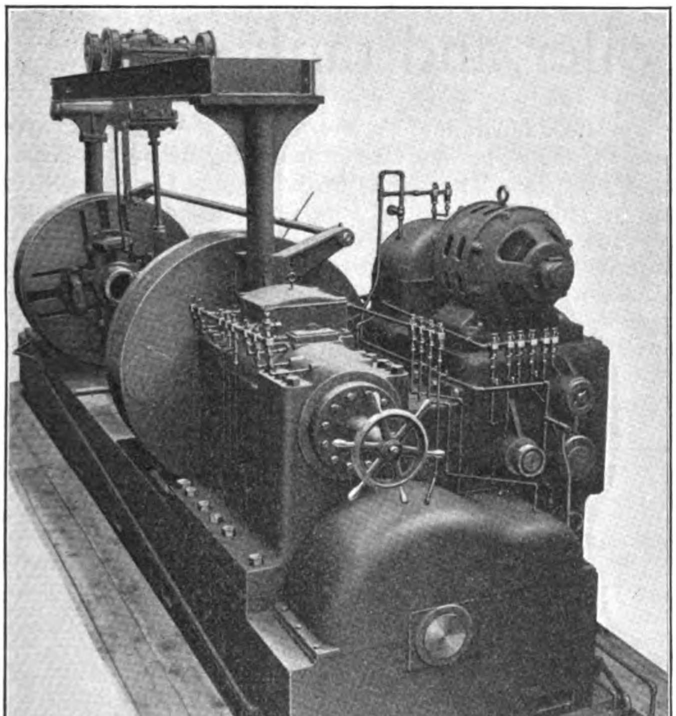


Niles-Bement-Pond open type car wheel lathe driven by a 50-hp. motor

These bearings, it is claimed, absorb but one-seventh of the power consumed by a plain step bearing. They reduce the power loss through friction and increase the power delivered at the cutting point of the tool. Four semi-automatic drivers are fitted on each face plate and firmly grip the rims of the wheels. These drivers are adjustable radially for different wheel diameters.

The right hand headstock is traversed along the bed by power through a large screw driven by a separate motor located at the end of the bed. A self-alining ball bearing takes the thrust from this screw. A safety feature, called a torque limiting friction, is located on the end of the screw. It can be so adjusted that the drivers on the headstocks can be brought up against the wheels with just the proper amount of lateral thrust to grip the wheels firmly. When the headstock is withdrawn this slip friction becomes a positive clutch. An electric switch acts as a safeguard against accident by limiting the lateral motion of this headstock. Pneumatic power clamps, one at the front and one at the back, clamp the right hand headstock to the bed simultaneously. If air is not available an electric clamp can be used.

The bed is of execeptionally heavy, deep box section and is reinforced at suitable intervals by rigid box braces.

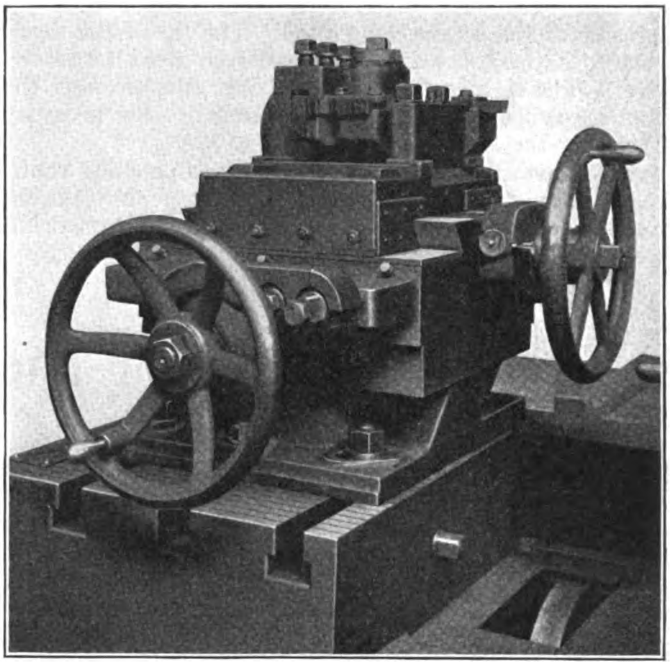


End view of car wheel turning machine, showing lubricating system

The flat ways on the right hand end of the bed which are subject to wear from the sliding headstock, are provided with renewable steel wearing plates. The left hand end of the bed projects beyond the driving head to accommodate an out-board bearing for the large driving gear on the drive shaft and its pinion.

The lathe is thoroughly lubricated. A special automatic lubricating system has been developed which greatly reduces friction, power consumption and should greatly reduce expensive repairs, shut-downs and maintenance. A geared pump keeps the oil level in a large tank located in the upper part of the drive box filled to the high level of the lubricating system. From this tank, trunk lines carrying adjustable sight feed lubricators supply each bearing with the proper amount of oil. The gear trains are continuously flooded with an unrestricted flow of oil. All used oil from both headstocks drains to a reservoir under the floor where it is filtered and again pumped to the upper tank for circulation.

A new design four sided flat turret tool post carries the four cutting tools for roughing, flange roughing, flange and tread finishing, and chamfering operations. Each tool, when indexed, comes into its cutting position



The left hand headstock, showing the arrangement of the tool holder

with a minimum amount of horizontal adjustment. Tool blades are securely clamped to the tool blocks and can be quickly removed for sharpening or replacing. Each tool post is mounted on a lateral feed slide which fits into the top surface of a cross feed slide. The wearing surfaces of both cross slides and lateral feed slides are covered by renewable hardened steel plates. The cross slides provide in and out adjustment for setting the depth of cuts. They are mounted directly on top of heavily built bases which are adjustable on the bed by rack and pinion to accommodate different size wheels. Four bolts clamp each firmly to the bed when set in the desired position.

There are power lateral feeds to both right and left hand tool rests. The feed ratchets are totally enclosed and so arranged that the feed may be thrown on or off by means of a pawl which also controls the direction of the feed. A feed change disc readily accessible to the operator makes it easy to change to any of the six available feeds which vary from 3/32 in. to 9/16 in.

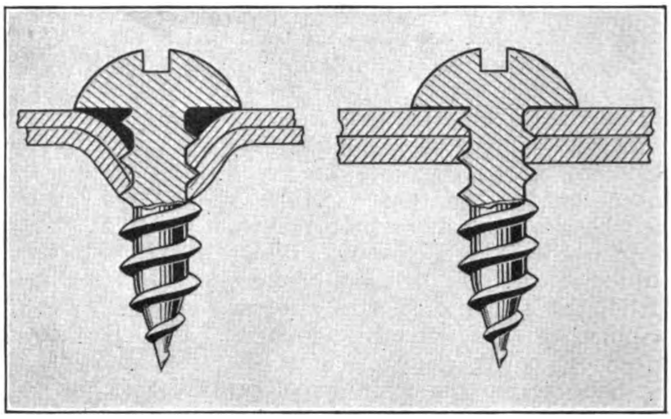
Short ends of tracks, attached to a steel telescoping cover which extends between the face plates, line up with the shop tracks when the movable headstock is in the charging position. Wheel sets are then rolled in and raised by a pneumatic hoist for chucking. A calipering device consisting of an adjustable pointer on a bar rigidly supported by the headstocks makes it easy to turn both wheels to the same diameter.

Self-tapping hardened steel sheet metal screws

SELF-TAPPING, hardened steel screws have been designed expressly for sheet metal work by the Parker-Kalon Corporation, New York. They differ from the ordinary wood screws in that they have a straight body and a special thread which extends all the way to the head so that the screws can be driven until the head is flush with the metal. The screws are hardened by a process which makes it capable of cutting into sheet metal without injury to its thread.

To use these screws it is only necessary to punch or drill a hole through as many sheets of metal as are to be held together. The hole must be a trifle smaller than the diameter of the screw being used. The tip of the screw is placed in the hole and the screw driven in with a screw-driver. The tighter the screw is driven, the stronger the fastening is made. This method eliminates the necessity of tapping the sheets.

The screws can be used in such work as patching roofs, car interiors, etc., repairing water tanks, fastening lagging thimbles to engine jackets, and erecting and repairing sheet metal work around shops, building, etc. The screws are made in six different sizes each of which can be furnished with round or flat heads.



Sheet metal screws which cut their thread as they are driven through the metal sheets

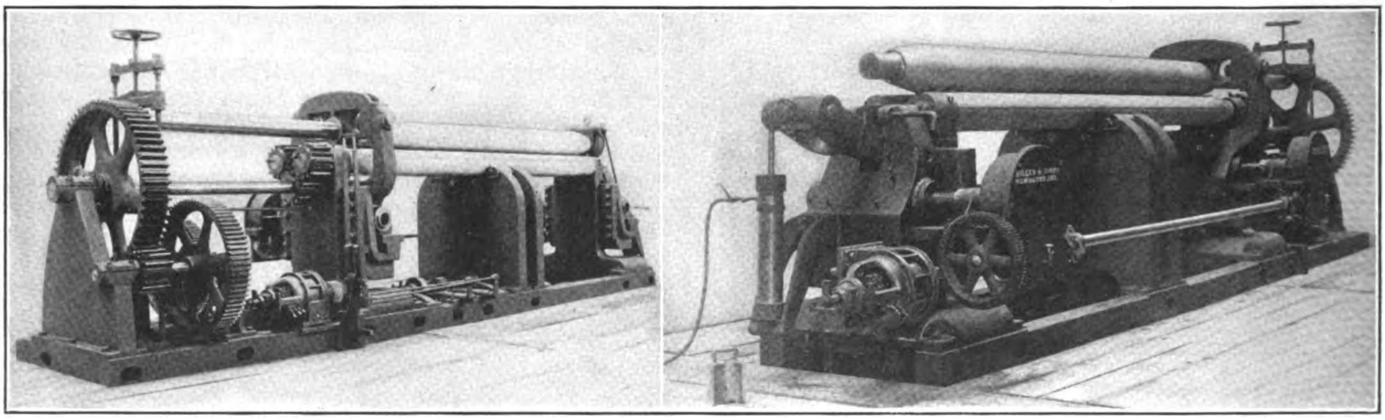
Bending rolls for the boiler and tank shop

ONE of the most troublesome problems in a tank and boiler shop is the flat place that is usually left on the edges of plates after being rolled on plate bending machines. Various methods of curving these edges have been employed for years, one the use of a heavy press, another mauling, and another the use of forming blocks on pyramid type rolls.

For a number of years the Hilles & Jones works of the Consolidated Machine Tool Corporation, Wilmington, Del., has been trying to evolve a plate bending machine, that would curve the sheet completely to the edge so that if desired the two edges may be welded, making a full cylindrical surface without any further work. Such a machine has recently been developed.

The capacity of the machine is rated to roll ⅜-in. soft plates 14 ft. wide, or corresponding duty, and the same type of roll is made in other sizes. On the particular machine mentioned, the upper roll is 13½ in. in diameter and is adjustable vertically to provide for pinching the plate and also has horizontal adjustment so that it may be brought over to the center of either one of the lower rolls. It is this combination of the vertical and horizontal adjustment for this upper roll that provides the means for bending a plate to a true radius to the edge. The top roll is also provided with a solid forged extension for counterbalancing it when the back housing is dropped down for the removal of plates rolled to full circles.

The mechanism operating the vertical adjustment of the upper roll is such that both ends of the roll are raised and lowered simultaneously or each end independently. Positive clutches provide for this arrangement and there is a vertical adjustment of 4 in. to the upper roll. The horizontal adjustment of the upper roll is 14½ in., or 7¼ in. each side of the center. The adjustments of the upper roll are by independent 10-hp. motors, one motor for the vertical adjustment and another for the horizontal adjustment. This is necessary to provide an independent flexible control for the two motions. The lower rolls are each 10½ in. in diameter. with a center to center distance of 14½ in.



Front and rear views of bending rolls which curves the sheets completely to the edge

An important feature of this design is the air cylinder which is provided for lowering the yoke for the removal

of plates rolled to full circles. This air cylinder serves to eliminate the use of a crane, which is the usual practice for lowering the yoke, and this one feature materially increases the speed at which plates may be handled through the machine. The plate travel is 15 ft. per min. The driving of the lower rolls is by a 20-hp. reversing motor.

Worm and worm wheel drives are used for both the vertical and horizontal adjustments of the upper roll. Each worm and worm wheel are totally inclosed and run in oil. All gears have teeth cut from the solid. The weight of the machine without electrical equipment is 72,000 lb.

Bullard power operated chuck

ANY analysis of machining time on chucked work includes, in the aggregate, a considerable amount of time required to chuck the piece in either standard chucks or fixtures. While the function is, of course, necessary to production, it is not directly productive and any saving which is made decreases idle time and increases productive time. On single spindle machine tools, chucking time is a definite factor in the process no matter what portion of the productive time it comprises. In the multiple spindle machine, where loading is done simultaneously with machining, this factor only becomes important when the rate of machining crowds the operator beyond his capacity.

As a definite step forward in the elimination of idle time and constructively increasing machine production, power chucks of various designs have been used. Some of them have been designed to reduce only the fatigue factor in the operation, while others have made definite steps toward increased production and greater economy in the process. The design of a power chuck should provide for only a simple motion by the operator. Its action must be positive and dependable while its mechanism must remain simple and of ample strength. Insofar as possible its complete function should be self-contained with power derived from the same source as the machining function rather than dependent on accessory or external forces which may be subject to fluctuation and interruption separate from the primary machine operation. A power chuck should also permit a definite control of the gripping power exerted on the work; for proper chucking requires simply the holding of a piece against the machining operation, and both accuracy and efficiency of the job may be as adversely affected by over-chucking as by insufficient support against the cutting operation.

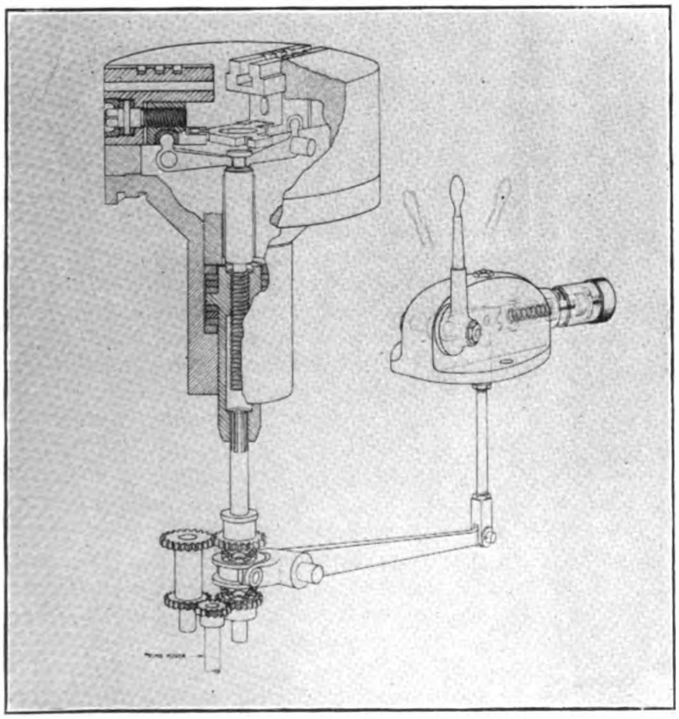
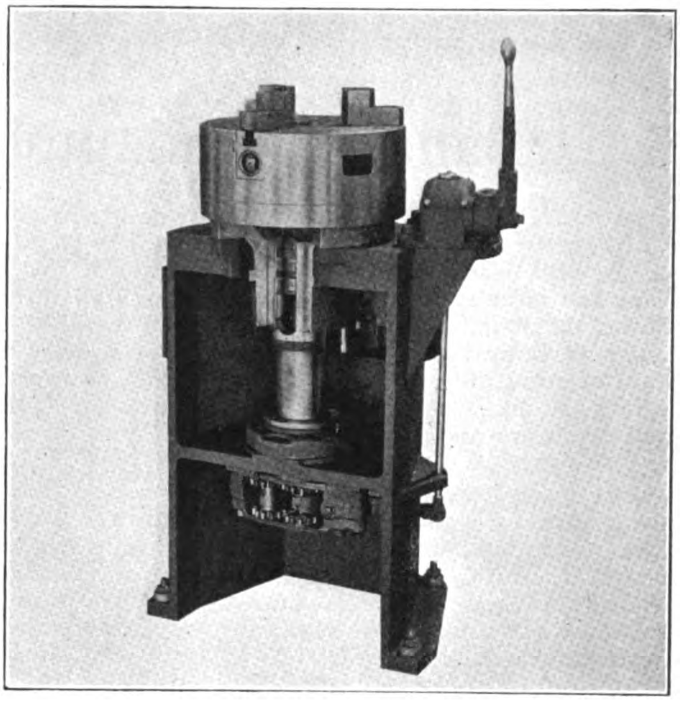


Diagram showing the construction of the Bullard power operated chuck

With these points in mind, a power chuck has been designed by the Bullard Machine Tool Company, Bridgeport, Conn. and placed in used on its various types of machines. The primary actuating motion of the mechanism is a vertical pull exerted by a screw and nut. This motion is transferred to the three jaws of a standard chuck by a bell crank lever and may also be adapted to the operation of special fixtures designed with its use in mind. The construction, as shown in the illustration, clearly indicates that when once the pressure is set by power it cannot be released except by reversing the motion. Its operation is controlled by a double clutch with angular teeth and compound gears which provide power in either direction from a common source. The driven member of the clutch is brought in contact with either forward or reverse drive by connection with a hand lever operating through a dart. The spring tension is so calibrated as to actually weigh the load of the pressure on the jaws. In operation it is simply necessary to throw the lever engaging the clutch for either forward or reverse

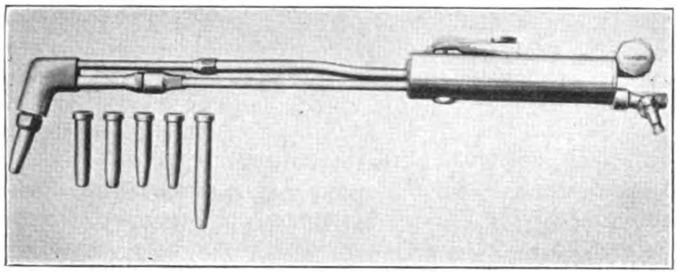


Power chuck which receives its primary actuating motion through a screw and nut

movement. The clutch is automatically disengaged when the movement has been accomplished; and it is impossible to build up an excessive jaw pressure by holding the clutch lever in the engaged position. The time required for operating the chuck in either direction is two seconds.

Low pressure cutting and welding torch

A LOW pressure torch which will operate on either low or high pressure gas with equal efficiency is being manufactured by the Alexander Milburn Company, Baltimore, Maryland. It is especially constructed to operate with the low pressure acetylene gas, city gas or hydrogen. It may also be used with a low pressure acetylene generator.



Low pressure torch provided. with solid copper tips

The manufacturer has utilized in the design of this torch the various parts of its standard cutting and welding torches. A correct and intimate mixture of the oxygen and acetylene has been obtained with non-flashback qualities. The torch may also be adapted for welding as well as for cutting by the interchange of tips. It is claimed that it can efficiently perform practically all the cutting and welding operations within range of the process.

It is constructed of bronze forgings and special seamless tubing, designed to withstand constant service. The tips are made of solid copper and are interchangeable on a large number of low pressure torches of other makes.

Band saw adaptable for motor drive

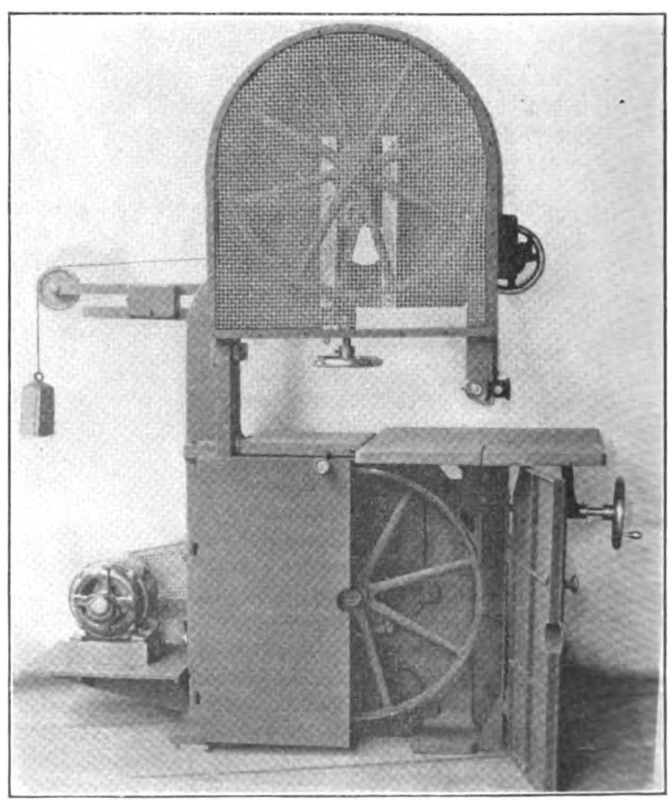
A LINE of band saws of improved design has recently been brought out by the American Saw Mill Machinery Company, Hackettstown, N. J. This line includes various sizes ranging from 20 in. to 36 in., the 30-in. size of which is shown in the illustration. These machines have been designed with the principal objective of providing convenience of operation, accuracy and durability. The design for all sizes is massive and the column and frame is of sufficient weight to insure against vibration.

The upper and lower wheels for the 30-in. size are of the solid spoke type 30 in. in diameter and have a 2-in. face. The manufacturer has also provided an optional design in which, if preferred, the lower wheel can be equipped with a special brake attached to the bolt shifter to stop rotation of the wheel quickly. Both wheels are keyed to ground steel shafts. The collar is forged solid on each shaft against which the hub of the wheel is firmly held by a large nut. Both the top and bottom shafts run in extra long bearings, made in two parts to take up the wear and are adjustable to provide for alinement of the saw blade. The upper wheel bearing is hinged for tilting of the wheels by means of a lever located in a position convenient for the operator.

The saw guide is of a special anti-friction design and is mounted on a counterbalanced square post. A hand wheel is provided for raising and lowering the guide post with one hand so that the workman may devote his entire attention to the work. The straining device for the upper wheel is of wide range and is sensitive due to the use of both a spring and weight. The slide head which carries the upper wheel bearings slides in a groove in the column and is held in place by steel gibs.

The table is 20 in. by 32 in. and is made rigid by extensive ribbing on the underside. It is cast face down to insure a clean surface and after being machined is scraped and polished. A hand wheel and screw are provided for tilting the table to 45 deg. for bevel sawing and it is equipped with a brass index and pointed to register its position. A lock fastens the table in any position.

As shown in the illustration, the various moving parts of the band saw are well guarded. The front side of the upper wheel is protected by a hinged wire guard and iron doors are provided for the lower wheel. The saw is fully



Motor driven band saw fully protected with safety guards

protected by the upper and lower guards in the rear and a guard follows the guide in front. An iron cover is also provided to enclose the machine back of the wheels. The lower pulley and belt are protected by wire mesh.

A feature of this machine is the provisions made for motor drive. A two or three horsepower motor is recommended to operate it. The two-horsepower size is sufficient for ordinary shop work, but the three-horsepower is recommended for heavy work. The design is such that the motor can be set on the floor and bolted to a pulley drive or set on a special bracket attached to the body of the machine and provided with a gear drive.

A 26-in. high power turret lathe

THE International Machine Tool Company, Indianapolis, Ind., has developed a 26-in. high power turret lathe of improved design. The general description of this machine is somewhat similar to the general purpose lathe of the same size which has been manufactured by this company for some time. The method of drive and the design of the headstock has been changed, making the drive more direct. The general method of feeds, speeds and rapid traverse for the tool post and the turret are the same as in the older machine.

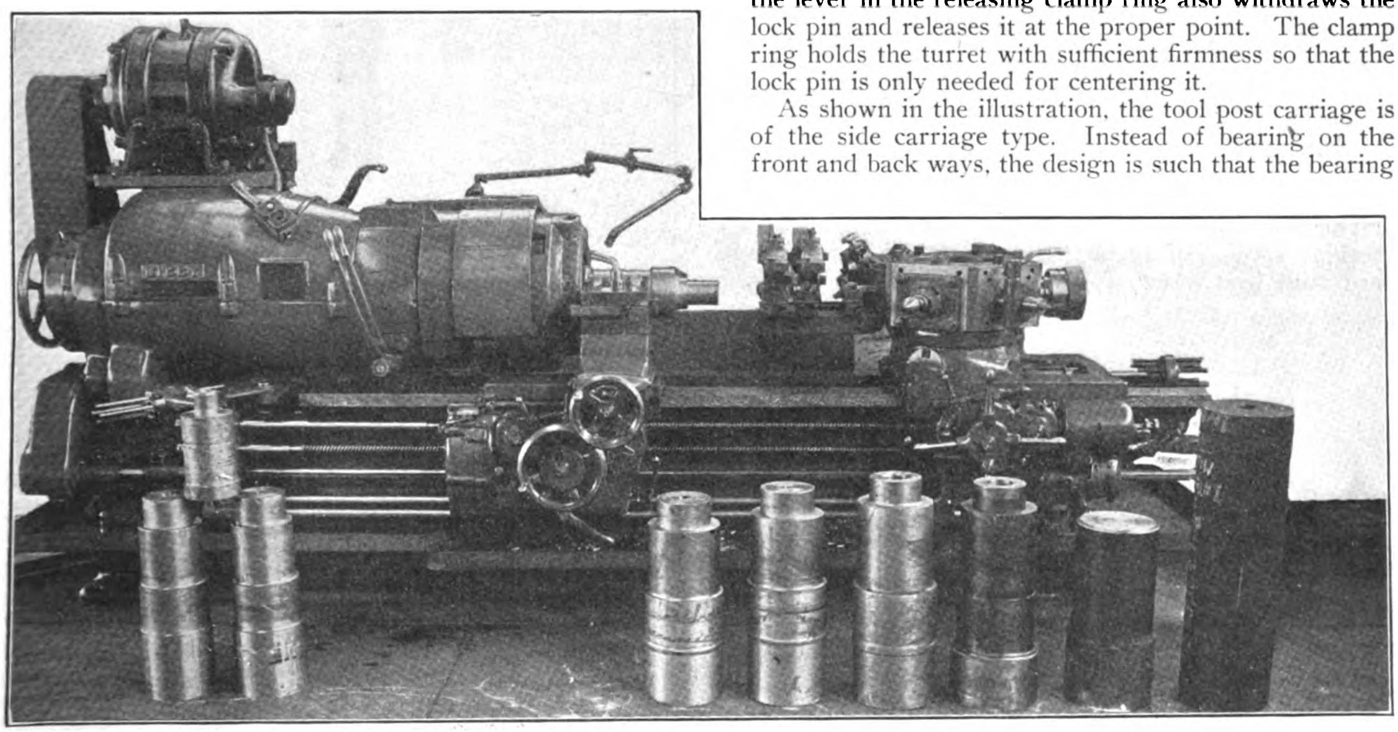
The gears in the headstock are made of steel with a wide face and course pitch. The two driven gears on the spindle are located one on either side of and close to the front main bearing. The chuck ring gear is 22 in. in diameter, keyed and bolted solidly to an 18½-in. flange, forged on the spindle. The friction drives are of large diameter and are located on the high speed drive shaft. Eight gear ratios are available ranging from 3.36 to 1 up to 57.6 to 1. The spindle and shaft bearings are of phosphor bronze. The main spindle bearings are adjustable for wear and are equipped with ring oilers. The point of the spindle is of .50 per cent carbon steel and the nose is threaded to receive the chuck. The seat is tapered so as to centralize the position of the chuck which is of special design and has three 23-in. movable jaws.

The bed and bedstock housing is in one casting. The bed is cross-ribbed every 11 in. and has a longitudinal rib through the center. The ways are of flat design, the front way being 6 in. wide and the back way 4½ in. wide. These ways provide a wide bearing surface for the carriages, the design of which is such that the force of the cutting strains on the spindle is transferred direct to the ways. The front way is undercut 15 deg. to receive the long taper gib for both the tool posts and turret slides, which takes care of the side thrust of both carriages. The turret slide is of heavy construction, 30 in. long and having 315 sq. in. of bearing surface on the bed. It is gibbed to the front way by a long taper gib and is also gibbed to the underside of the ways. A positive clamp to hold the slide stationary when using the centers is also provided.

The turret is a hexagon 18 in. across the flats and has six 4¼-in. holes. The faces are 9 in. wide by 8 in. high. The turret rests on a base 17 in. in diameter which is centralized by the cone seat. It can be securely clamped on the outside diameter of the seat by a double clamp ring operated by an eccentric and lever. A similar action of the lever in the releasing clamp ring also withdraws the lock pin and releases it at the proper point. The clamp ring holds the turret with sufficient firmness so that the lock pin is only needed for centering it.

As shown in the illustration, the tool post carriage is of the side carriage type. Instead of bearing on the front and back ways, the design is such that the bearing on the back way is transferred to a taper gibbed bearing on the bottom of the front side of the bed. The 15-deg. undercut on the front way permits the tool posts to pass the chuck and permits turning and facing it up to the full swing of the machine. This design also allows the turret to be moved up flush with the chuck so that short stocky tools instead of long overhanging tools may be used. The tool post is of steel and will carry four tools at one time, each independently adjustable for height. It can be locked in any of the four positions and clamped in any desired intermediate position by means of a double acting clamping device.

Independent power rapid traverse is provided for each carriage. The carriages can be operated in either direction at a rate of 35 ft. per minute. None of the head-



Libby turret set up for turning out locomotive crank pins

stock or feed gears are used in the rapid traverse feed mechanism. The slides are operated by means of a hand wheel on the tool post slide and pilot wheel on the turret slide. One revolution of either wheel will advance the slide one inch. The power feeds are gear driven, the feed changes being made in the apron. The feeds for the turret and tool post carriages are independent of each other both as to direction and amount. They can also be reversed independently in either apron. All gears in the headstock are either steel or semi-steel. The gears in the aprons are of steel and are bronze bushed or run on hardened pinions. All gears and pinions are heat treated. Force feed lubrication is provided to all main bearings of the machine.

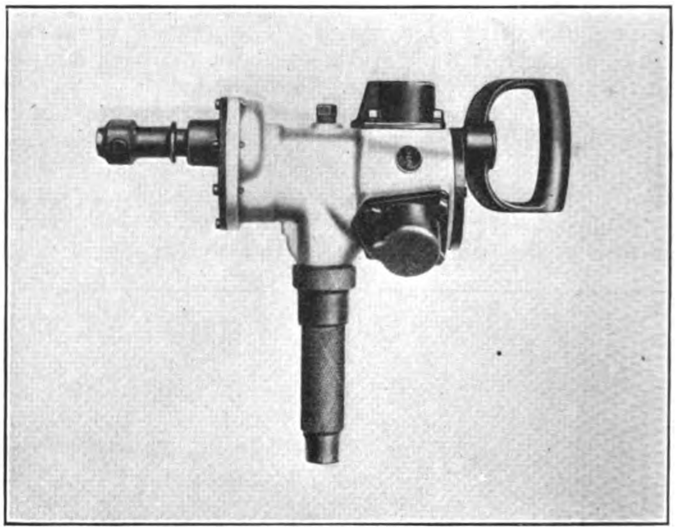
Pneumatic wood boring drill

A LIGHT, reversible wood boring machine has recently been placed on the market by the Ingersoll-Rand Company, New York, which is suitable for boring holes in wood up to 1 in. in diameter and is known as the size DD drill.

The features of this type of machine are briefly a special three-cylinder motor, a light weight aluminum case with steel bushings cast in place in all the bearing holes and the throttle hole, a renewable crank pin sleeve and cast iron cylinders which are renewable and interchangeable. The renewable cylinders permit any one cylinder to be easily replaced. The rotating parts of the three-cylinder motor are all accurately balanced, which eliminates vibration and reduces the wear and tear on the machine. All of its parts are readily accessible for inspection.

These drills are furnished with a spade handle and a bit chuck; a breast plate or feed screw can be substituted in place of the grip handle when so desired and a drill chuck in place of the bit chuck. The drill is thus made adaptable for a wide variety of work.

The following are a few of its specifications: Average working speed, 705 r.p.m.; total weight, 15 lb.; length of feed with feed screw, 2½ in. length overall (with grip handle), 15 in.; distance from side to center of spindle, 1 9/16 in.; size of hose recommended, ½ in.



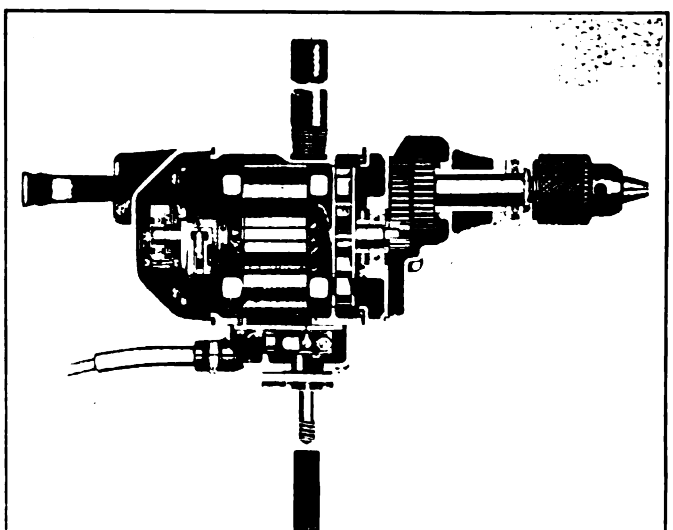
Ingersoll-Rand, three-cylinder wood boring drill

Standard duty half-inch universal drill

A STANDARD ½ in. universal drill is a recent addition made by the Hisey-Wolf Machine Company, Cincinnati, Ohio, to its list of portable electric machine tools. It can be furnished with either a 115 or 230-volt motor with a no-load speed of 525 r.p.m. capable of drilling or tapping steel up to ½ in.

The motor is designed particularly for electric drill service. The armature is hand wound with the lead ends firmly banded in place. The heavy armature runs in ball bearings which cannot slip, as the inner races are locked. The bearing on the gear end of the armature is mounted with a floating fit in a hard cast in sleeve, which is intended to obviate binding and internal friction. A tooth type stator gives an efficient magnetic flux distribution. The brush holders with an adjustable spring tension are mounted as a separate unit on a bakelite yoke. This arrangement permits brush adjustment when necessary. At each end of the motor shaft are felt washers for retaining the lubricant. They are firmly held between steel collars to prevent them from working loose or wedging. The motor is cooled by force ventilation drawn into the motor by a fan keyed on motor shaft.

The electrically heat treated gear on the armature shaft is removable. The spindle gear is carried on an oversize chuck spindle which is hardened and ground and automatically lubricated through the gear case. The chuck end of this spindle runs in over-size thrust bearings. The chuck is fitted to a hardened and ground tapered spindle. The Jacob's chuck is standard equipment.

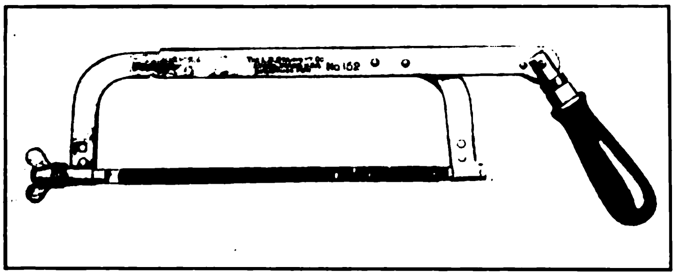


Removable end plate provides easy access to the motor of this machine

The end cover is a separate piece which carries all of the pressure applied to the spade handle, and being independent of the motor and motor bearing, relieves them of all strains. This construction also affords a convenient access to the carbon brushes for adjustment or renewal by the removal of three screws. The spade handle is directly in line with the drill chuck which tends to eliminate side pressure and reduce friction. For close quarter work it can be removed and the pressure applied directly on the end cover casting.

Starrett feeler gage and hacksaw frame

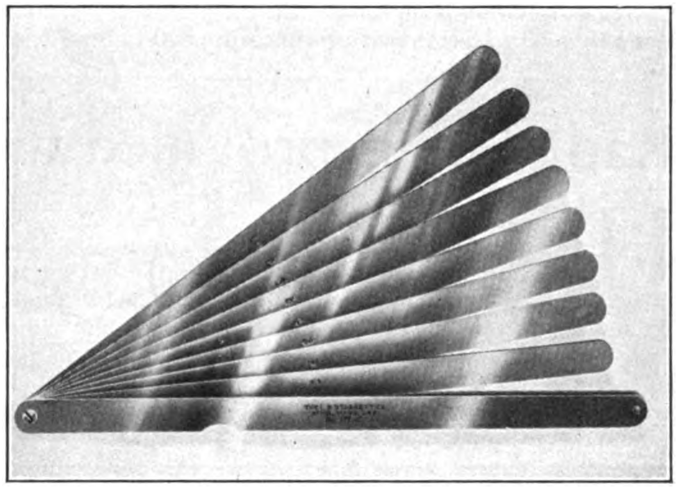
RECOGNIZING the demand, created by the maintenance of the many gasoline motors recently acquired by the railroads and in a lesser degree by the repair of machine tools, for a long leaf thickness or feeler gage, the L. S. Starrett Company, Athol, Mass., has brought out such a gage with eight leaves in the following thicknesses: .002 in., .003 in., .004 in., .005 in., .006 in.,



Hacksaw frame the handle of which can be adjusted to 13 positions

.008 in., .010 in. and .015 in. The leaves are ½ in. wide and 9 in. long and should one become damaged it can be easily replaced. The possibilities of this gage will be particularly appreciated when regrinding motor cylinders to take over size pistons.

Another tool of interest to those repairmen whose work calls for the use of a hand hacksaw in cramped quarters or strained positions, is the hacksaw frame shown in one of the accompanying illustrations. It will take any length of blade from 8 to 12 in. and has a handle which may



Feeler gage with unusually long blades

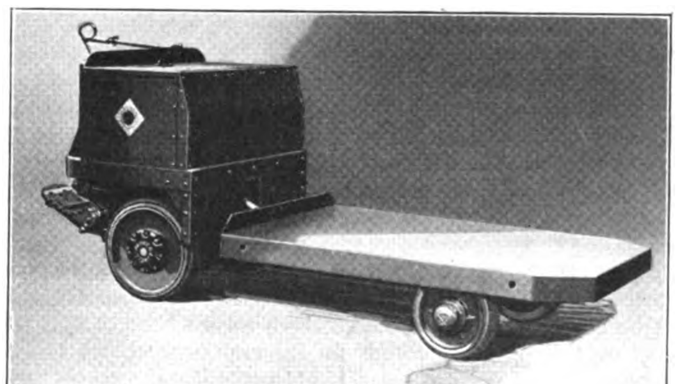
be adjusted to 13 positions in each of which it may be locked. The saw may also be quickly set to cut in any one of four directions with respect to the plane of the frame.

Large capacity electric lift tractor

THE success of the electric lift tractor within buildings has tempted many users to increase the range of this type to more distant points on the premises where runways are in poor condition. In most instances this has required the extension of runways, although some concerns have not given proper values to such improvements. On the other hand, yards and storage spaces often are so extensive that the laying of ideal trucking surfaces would possibly require a prohibitive investment.

The improvement of the trucking device has kept pace with the encouraging interest taken by the average user in its employment. The Elwell-Parker Electric Company, Cleveland, Ohio, has developed a heavier unit of the electric lift-type especially suited to travel runways not altogether smooth. This haulage unit is of broader gage than those designed particularly for inside operation. The gage of the front and rear wheels is the same, i.e., 30 in. They are fitted with 22 in. drive and 15 in. front wheels and with either 3½ in. or 4½ in. tread. The drive wheels are equipped with double row ball bearings weighing 13 lb. each, and radial and thrust bearings measuring 7 in. in the outside diameter.

These wheels are carried on drop forged knuckles with drop forged levers pressed on tapered serrations, assuring a firm union of the two. These knuckles support the weight of the axle, frame and load on a steel ball bearing recessed in a cup at the upper ends. The levers are fitted with ball ends received in the steering rod sockets. All



Electric lift tractor specially suited to travel over uneven runways

the rods are placed high beneath the platform to avoid contact with obstructions on runways. The full-floating, alloy steel, drive shafts are pressed into drop forged clutch

plates bolted to the outside of the drive wheels, these shafts being fitted with chrome-vanadium universal joints and engaging the splines of the differential.

An innovation in tractor design is found in the all-drop forged differential. The differential carries a special Brown & Sharpe phosphor bronze worm wheel, lock bolted between the two halves of the drop forged differential cage. A multi-thread steel worm on radial and thrust bearings with the above parts of the differential, are assembled and adjusted at the bench and the whole dropped into the axle differential pot. A new type of universal joint, inside the brake wheel, connects the drive worm to the motor shaft with a demountable armature. The motor is fitted with ball bearings.

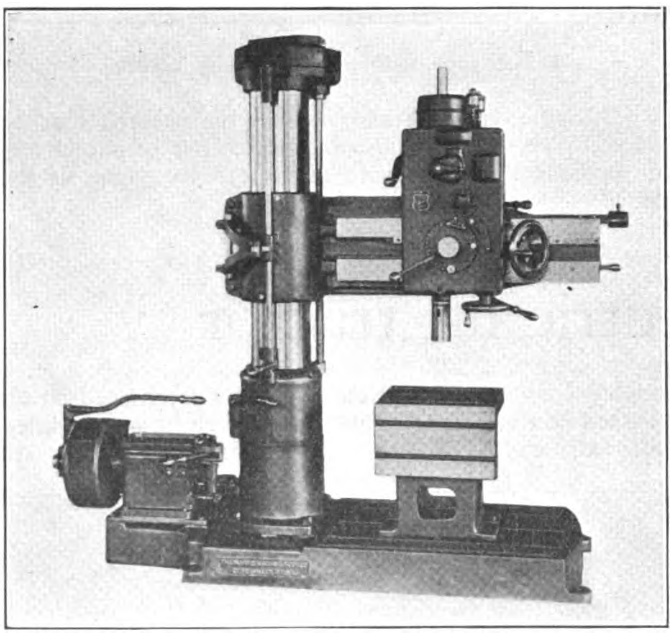
Another feature is the flexibility of the drive unit when traveling over rough surfaces when the platform is loaded unevenly. The tractor platform measures 40 in. by 72 in. and is formed from a single steel plate with deep side flanges. The platform nose is tapered to aid its insertion beneath a skid even though approached from an angle. The lift of the platform is 6½ in. It is 17 in. high when in the lowest position and 23½ in. when raised. Clearances are important when the tractor crosses door-sills, passes over the crest of an incline or a wheel drops into a runway depression. The frame on this tractor is of standard commercial angles and heavy channel sections, hot riveted throughout, and offers possibilities for varying platform lengths.

The low set, all-steel battery compartment at one end is fitted with removable end doors and a hinged cover to facilitate the inspection or quick exchange of the storage batteries. The wire leads between the controller and the battery are continuous—no splices—to the motor brush studs and the motor field coils.

Radial drill provided with a tapping attachment

HIGH speed radial drills in 2-in., 2½-in. and 3-in. sizes, and heavy duty radial drills in 3-in. and 3½-in. sizes have recently been brought out by the Morris Machine Tool Company, Cincinnati, Ohio. The design of all of these machines is basically the same.

The head is fully enclosed and well balanced on the arm so that it travels freely. An adjustable taper gib is provided to take up the wear. One lever operates two clamp screws which securely clamp the head on the arm without affecting the alinement. Oil is properly distributed throughout the head from an oil reservoir at the top of the head by filling an oil cup once a day. The feed worm wheel dips in a trough of oil.



Morris radial drill provided with a tapping attachment and a well designed lubricating system

The spindle is a steel forging which runs in phosphor bronze bearings in the sleeve and is driven by two keyways. It is fitted with ball thrust bearings and the spindle gear is mounted on a ball bearing. The sleeve is of steel, fitted with bronze bearings and the rack is cut directly in the steel sleeve. The helical spindle gears are made of a special alloy steel and are of small diameter, keeping the peripheral speed down to a minimum and thus reducing the possibility of trouble when reversing on high speeds.

The feed gears are enclosed within the head and provide six feeds. These are marked on a dial in .001-in. increments per revolution of the spindle. The feed can be automatically tripped at any depth within the traverse of the spindle. The tapping attachment and back gear bracket is a unit mounted on the back of the head. The friction plates in the tapping attachment are of the multiple disc type. A simple and quick adjustment is provided from the outside of the casing. The tapping capacity in cast iron is up to 2½ in. using a pipe tap. The back gears, back gear clutches and spindle gears are Chrome nickel steel.

A speed chart at the change-speed lever permits the operator to quickly select any one of the 18 spindle speeds. The speed box is of the sliding gear type and is equipped with ball bearings. The gears run in oil and the ball bearings are lubricated by the splash from the gears. The driving pulley is fully enclosed and fitted with a friction clutch operated by a single lever. It runs on ball bearings when the clutch is disengaged.

These machines can be arranged for a constant speed motor drive in connection with the speed box, or a variable speed motor with a 4 to 1 ratio, mounted on the base in place of the speed box and geared to the lower shaft. The variable speed motor may also be mounted on the back of the arm or a constant speed motor and ball bearing speed box, mounted on the arm. This construction eliminates four bevel gears and three spur gears.

The cone drive in connection with a double friction countershaft gives 20 spindle speeds. The countershaft pulleys are 12 in. by 3¼ in. and run at 520 and 600 r.p.m. The column or sleeve which is 9¾ in. in diameter, is mounted on an inner column which extends through to the top and revolves in a ball bearing. The column cap is equipped with an oil reservoir with oil leads to all the bearings.

The arm is designed to resist torsional and lifting strains and the bearing on the column is extra long so that the arm can be clamped in any position by a single lever convenient to the operator. The arm is raised or lowered by a power controller through a lever at the bottom of the column. This lever accomplishes two purposes. First, it automatically unclamps the arm before the elevating or lowering gears are engaged by the movement of the lever. A little further movement of the lever engages the gears and the arm is raised and lowered to its desired posi-

tion. In bringing the lever back to its central position until the latch catches, the gears are disengaged and the arm clamped by one movement of the lever. This is not only a positive safety, preventing the gears from being engaged while the arm is clamped, but it performs the operation three to four times faster than the old method of unclamping the arm before raising and lowering it.

The base is heavy, deep and well ribbed and is provided with T-slots. The oil channel around the base drains through a screen to a large reservoir, having an overflow partition to keep the chips and dirt out of the pump and thus preventing clogging of the lubricating system.

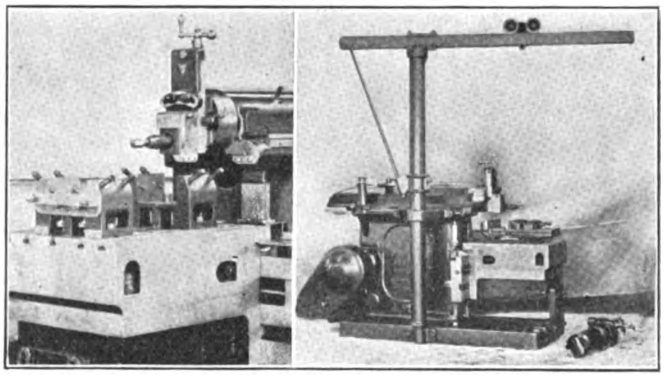
Shaper designed for the railroad shop

A 32-IN. shaper intended principally for railroad work, and arranged particularly for the complete machining of locomotive driving boxes and their accompanying shoes and wedges, driving box crown brasses and rod brasses has recently been placed on the market by the Cincinnati Shaper Company, Cincinnati, Ohio. It is equipped with a special table, extended circular feeding head as well as a standard head, special shoe and wedge chuck, standard vise, and a 1,000-lb. boom crane, and an indexing fixture for planing driving rod brasses. A power-driven rotating fixture for crown brasses can also be supplied, if desired. The machine is arranged either for belt or motor drive.

The special table is arranged with a removable top, 9½ in. deep, which provides a wide range of distances between the ram and the working surface of the table. This top is left in place when planing the crown brass fit in the driving box, as shown at the right in Fig. 1, planing shoes and wedges, or when doing the usual run of shaper work, either with or without the standard vise. It is removed when planing the shoe and wedge fits in the driving boxes, and, when used in this way, provides sufficient height between the table and the ram to permit the largest driving boxes to be placed directly on the table. As can be seen at the left in Fig. 1, mounting the work in this way keeps it directly in line with the outer table support and insures the greatest possible stability for the cut.

The working surface for the upper table is 32 in. by 24 in. and that of the lower table 24¾ in. by 24 in. Both are provided with suitable T-slots and the upper table has holes conveniently located into which stop pins may be inserted. The outer support for the table is effective at all heights whether the removable top is on or off. Also, at no time does any part of it project above the surface of the table in use.

The circular feeding head, as shown at the right, Fig. 1, is used in planing out the crown brass fit in driving boxes and will plane out such fits from a minimum of 8 in. in diameter to a possible maximum of 18 in. in diameter. It is strong and rigid, the extended body being bolted directly onto the end of the ram with four heavy bolts. It may be rotated either by hand or automatically in the same manner as the down feed on the standard shaper. This circular feeding head is furnished in addition to the standard head and interchanges with it on the circular T-slotted end of the ram.



At the left the shaper has the shoe and wedge chuck mounted on the special table—The right view shows the circular feed head removed and the vise mounted on the table

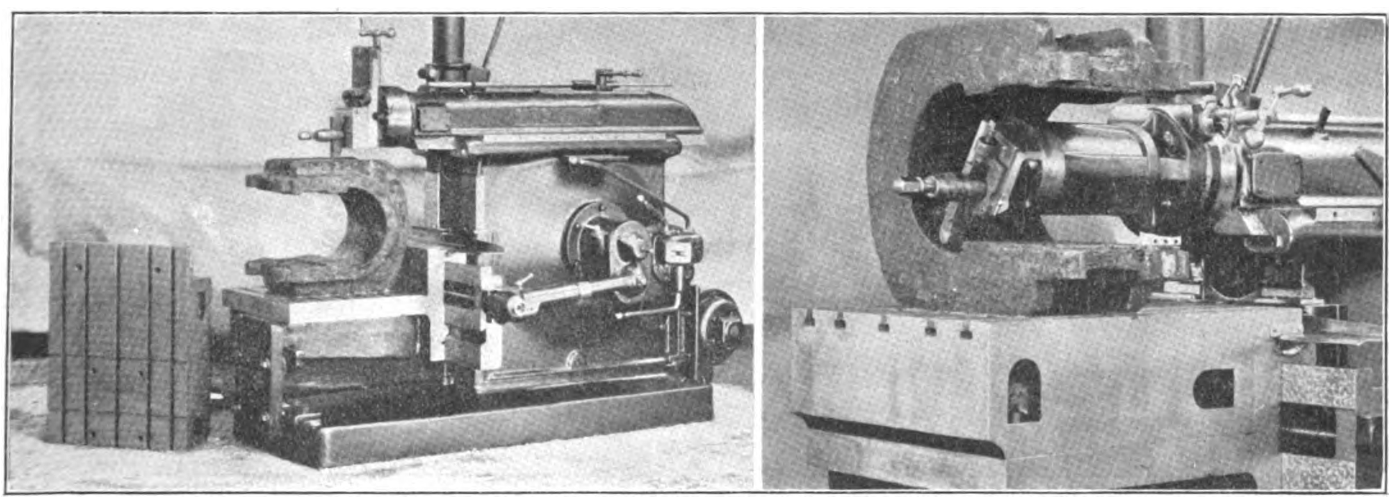


Fig. 1.—The view at the left shows the shaper set up for machining the shoe and wedge fit of a driving box with the special table on the floor—The right view shows the special table on the shaper with a driving box set up for machining the crown brass

The special shoe and wedge chuck is arranged to handle both small and large shoes and wedges, and is made in two parts which can be adjusted on the table to suit short or long work. Making the chuck in this way permits the operator to set his surface gage directly on the shaper

table when lining up the lay-out marks or punches. The work rests on four adjusting screws which are conveniently located and very accessible, and which can easily be adjusted to line up the layouts, and is held down by eight screws coming in at an angle from the sides. The front half of the chuck is provided with an end stop bar so that very heavy cuts can be taken.

The boom crane is comparatively light for quick handling, but strong and rigidly constructed with ample capacity for carrying loads up to 1,000 lb.

An unusually strong and heavy vise also is furnished. It is of the double screw type and is of compact design having its working surface but 5 in. above the working surface of the shaper table. The jaws are 3 in. high and 15 in. long, and the vise opens 15 in. An unusual feature of this vise is that but four bolts are used, the same bolts being used for swiveling and for securing the vise to the table. One size wrench only is required for the vise, table support screws, and all the various other clamping nuts which the operator uses for making his settings and adjustments.

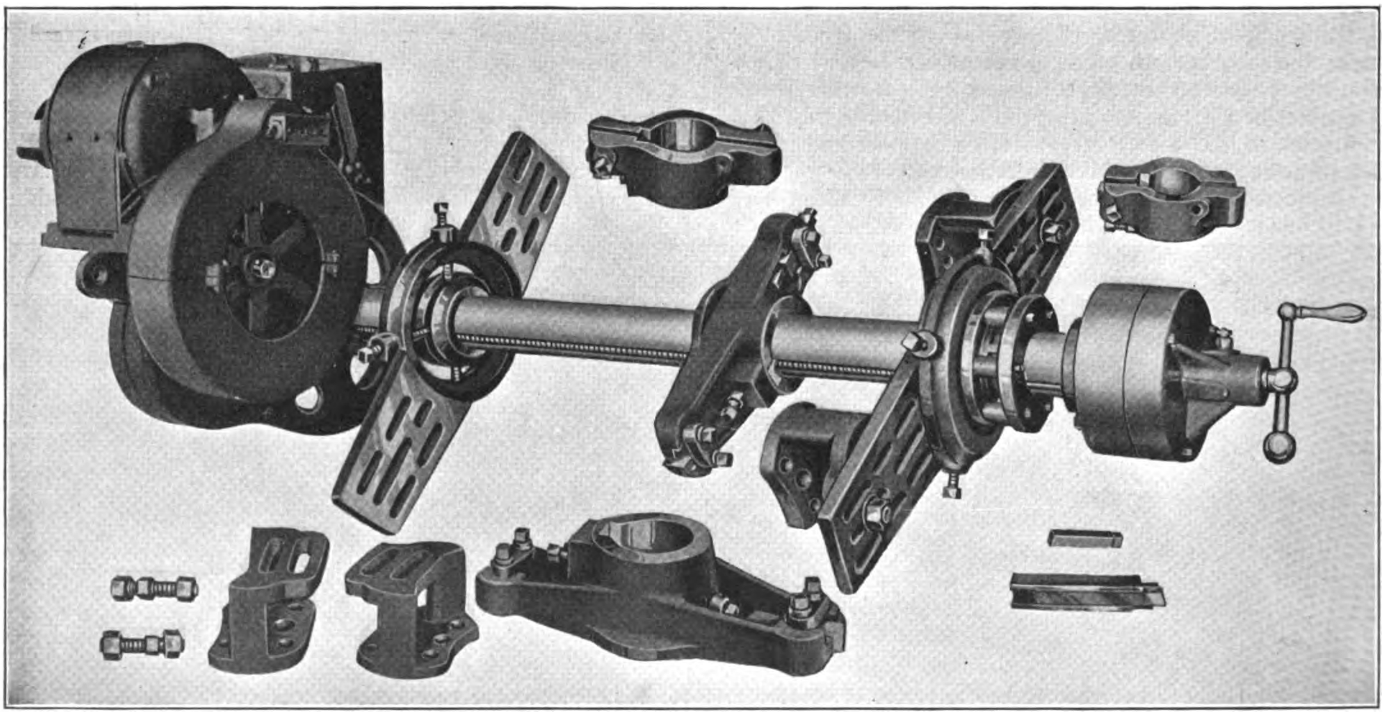
The machine is automatically oiled, which provides adequate lubrication to all the moving parts of the machine including the ram ways and rocker arm mechanism. Eight speeds are obtained through the internal transmission which is entirely within the column and runs at all times in a bath of oil. The various feeds are operated by cams which insures smoothness of action. The feeding mechanism is fully enclosed and also operates in oil. The stroke lengths are rapidly and positively set without necessity for starting the machine to determine the length of each stroke.

Motor driven cylinder boring bar

MANY locomotive repair shops and engine houses are equipped with motor-driven machine tools. Conforming to this practice, E. J. Rooksby & Co., Philadelphia, Pa., has developed and placed on the market a motor driven portable cylinder and valve chamber boring bar.

The improvement in the design of this machine consists principally in the manner of driving the bar by means of an electric motor. The motor is mounted on a suitable base on the gear drive frame, forming an integral part constant speed motors. Should a variable speed d.c. motor be desirable, the speed gear box is not required. The motor may be controlled by an ordinary switch or by an automatic remote control magnetically operated switch, with a start and stop push button station. This latter type is particularly desirable in portable tools as the push button station can be mounted on the gear drive and the switch box placed in a convenient place out of the way of the operator.

The main gear drive is provided with gear guards cast



The motor forms an integral part of the boring bar for boring out locomotive cylinders and valve chamber bushings

of it, the speed reduction being accomplished by mechanical gearing. The gear box is provided with four changes of shifting gears which gives the operator a selection of four cutting speeds, suitable for the various diameters of cylinders within the range of the bar. The gears, which have a positive lock shifting device, are completely protected and are enclosed in a gear case and run in grease.

These machines are furnished with either d.c. or a.c. integrally with the frame, adding materially to the strength and safety of the machine as well as affording complete protection to the operator.

The bars are made of machine steel accurately finished. Long experience has shown that where more than one tool is required to be used at a time, two tools placed on directly opposite sides of the bar produce the best results. Double arm cutterheads have been designed to accomplish this. They are fed along the bar by a totally en-

closed feed box which is automatic and continuous in operation.

The economical and successful operation of any machine tool is very largely governed by a properly designed tool holder and cutting tool. An extra heavy tool holder for use with high-speed steel or Stellite cutters is provided with this machine.

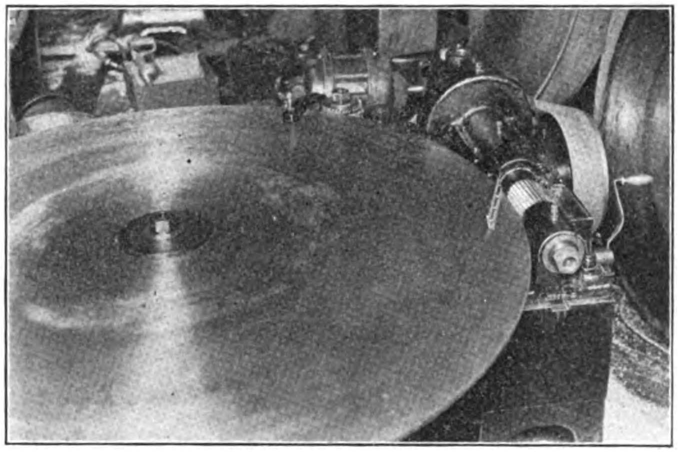
The machines are made in bar sizes of 3 in. to 6 in. in diameter and designed to bore valve chamber bushings or cylinders ranging from 7 in. to 48 in. in diameter.

Machine for reconditioning friction saw blades

THE usual method of sharpening friction saw blades by forming the teeth in the periphery with a hammer and cold chisel seldom resulted in a blade nicked uniformly and to the proper size. The metal is merely displaced by the chisel, thereby widening the rim which increases the power consumption necessary in cutting and also increases the amount of waste on each cut. The rounded mushroom edge results in considerable chipping, and burrs are often left on the work. Blades sometimes fail in service on account of the small cracks or fissures between the teeth, often caused by nicking.

Recognizing these conditions the Joseph T. Ryerson & Son, Inc., Chicago., has developed a machine which sharpens and trims the blades, making them ready for use practically as good as new. The machine consists primarily of a centering and leveling frame, which holds the blade horizontal while a milling and serrating hob applied to the edge of the blade revolves it and at the same time mills the desired grooves, trimming the rim so that the periphery is left true. At another point on the circumference of the blade, a pair of milling cutters removes the slight mushroom effect from both sides of the blade. The hob and milling cutters used, will form teeth in any standard blade regardless of the hardness of the steel.

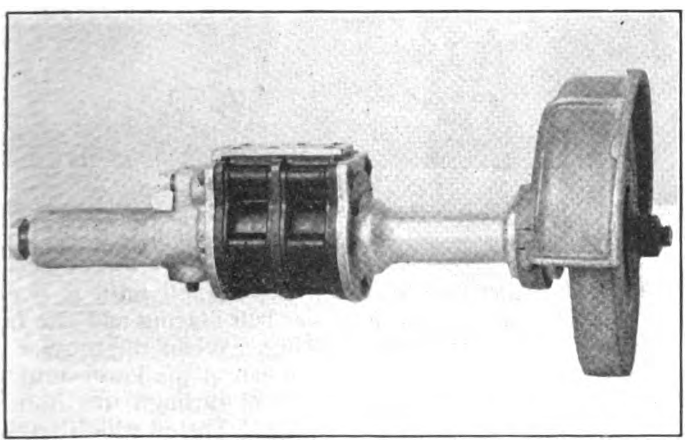
The work is performed quickly and the teeth cut perfectly according to the specified size and spaced evenly at the proper angle to the radius of the blade, so that they have all the strength and resistance of a new blade. The ease of operation of the machine makes it possible for a comparatively unskilled workman to use it.



Friction saw blade sharpener which mills and trims the blade in one operation

Pneumatic grinders driven by rotor principle

A LINE of pneumatic grinders which operate through the usual air line supply, but differing from the recognized types in that they use a rotor mounted on the drive shaft with the valve mechanism, controlled by a sliding valve, instead of pistons, has been developed by the Warner & Swasey Company, Cleveland, Ohio. This design confines the work to three parts.



Grinding machine which has only three moving parts

The method of rotation is as follows: Air enters through the air inlet; a small portion of it being conducted upward to the air cushion chamber and then deflected downward, exerting a constant pressure on the upper edge of the valve blade. This pressure maintains a sealing effect between the eccentric surface of the rotor and the valve blade, no matter what position the grinder is in. The main portion of the air entering the air inlet rushes in the cylinder causing rotation of the rotor in a clockwise direction. When the rotor has revolved about three-fourths of its cycle, the air moves upward to the exhaust chamber, and is exhausted through the ports. The two rotors which rotate in their respective cylinders are mounted directly opposite on the shaft so as to give a balanced effect, and overlapping power strokes. This gives a steady flow of power with a motion that is noticeable for its lack of vibration.

The three moving parts consist of the shaft assembly to which the two rotors are fastened by means of keys, all of which are made from Chrome Nickel steel. The two valve blades are made of a special light material which reduces momentum due to reciprocation.

Parts subject to wear have been reduced to a minimum. Disregarding ball bearing friction between the shaft and the two ball bearings on which the shaft is mounted there are but two points of friction contact. These are the points of contact of the two valve blades as they rise and fall on the eccentric surface of their respective rotors. The blades are made of a special fibre material, but since they are in contact with steel surfaces they must absorb such wear as occurs. When it is necessary to replace these blades, a screw driver is the only tool necessary. The cap is removed at the top of the grinder cylinders,

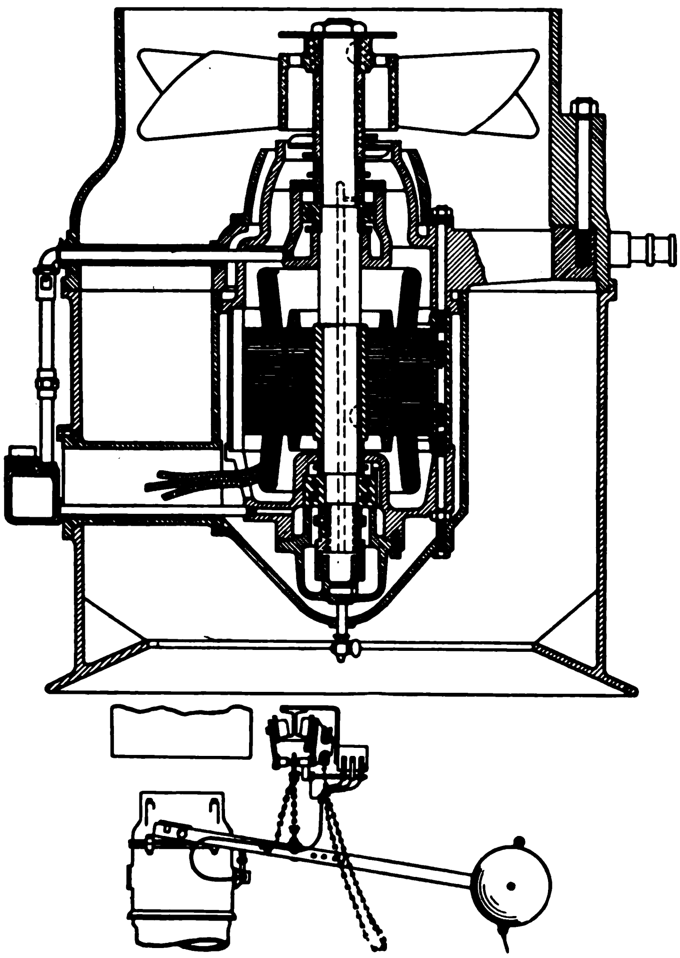
the new blades are inserted, the cap replaced and the grinder is ready for service.

There is no friction contact between the surface of the rotors and the cylinder walls. Ample clearance of from .002 to .003 in. is provided. The constant oil film present seals this clearance, preventing any air leakage past the rotor surface. An oil reservoir in the air inlet holds an ample supply of oil for the average day's run. This oil is fed into the cylinders in the form of a mist, and is easily adjusted by means of a needle valve. The grinders will operate efficiently at air pressures varying from 65 to 90 lb. with an air consumption of from 32 to 40 cu. ft. per min.

The machine is made in three sizes. The Type D-2 size is for general grinding with a free speed of 4,500 r.p.m. and weighs 15 lb.; the Type D-2-X size is for high speed buffing and polishing with a free speed of 6,000 r.p.m. and weighs 15 lb.; and the Type D-1 size is for the light grinding work with working speeds of 3,500 to 7,000 r.p.m. and weighs 8¼ lb.

Blower for drafting locomotives in enginehouse

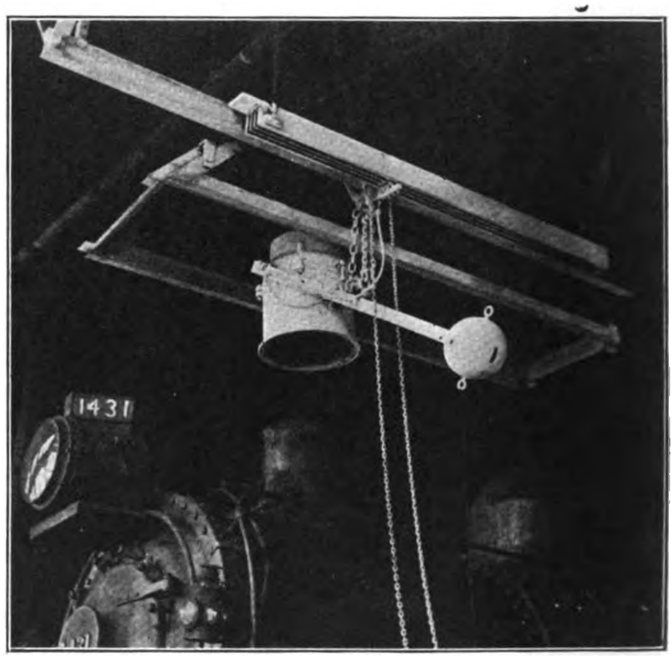
EVERY time the steam pressure in a locomotive is let down, it is necessary to draft it in the enginehouse so that it can pull out under its own power. The present method of drafting a locomotive is to connect the engine steam line to a steam jet blower located at the bottom of the stack. The Coppus Engineering Corporation, Worcester, Mass., has designed and placed on the market an electric operated blower known as the Locoblow which is a redesign of the blower of the same type which was first introduced to the railroad field in 1923.



Cross-sectional view showing arrangement of the motor and fan

The motor of the blower is essentially the same in capacity and design as that of the earlier type and the whole unit is similarly suspended from an I-beam monorail. The new blower, however, is more compact and lighter in weight and is much easier to handle from the enginehouse floor due to a balancing feature which makes it possible to raise the machine through the entire range of lift by a light pull on a rope attached to the end of a counterbalance. It may then be rolled over the stack by means of pulling the endless chain in the desired direction and lowered down upon the stack by releasing the rope. Current from the switch is led to three contact rails and is then carried to the motor through sliding copper contactors.

As some trouble was experienced with the earlier blower due to the lack of lubrication this feature has been given special attention in the design of the Locoblow as will be seen by referring to the cross-sectional drawing. Oil is poured into the reservoir shown to the left until it overflows: This submerges the lower ball bearing and the oil-filling chamber below this bearing. When the blower is in operation the screw thread shown at the lower end of the rotating element pumps the oil through the hollow shaft to an outlet over both bearings. The oil which passes over the top bearing enters a reservoir immediately below from whence it is returned into the oil chamber by way of suitable piping.



Motor driven locomotive blower which can be placed over the stack or swung out of the way by an endless chain

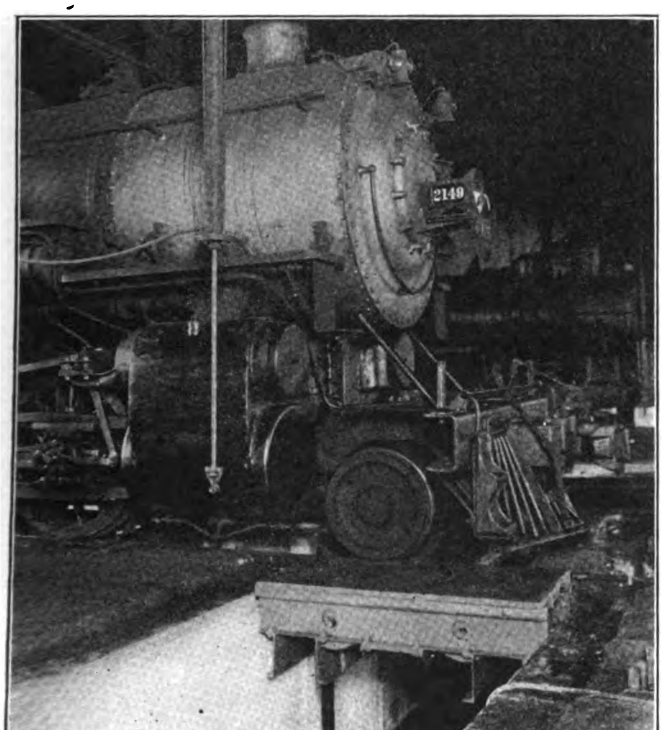
As the motor is suspended in the center of the blower in such a way that the gases must pass around it, special attention has been paid to ventilation. The motor is encased and a strong current of air passes between the outside of the motor and this casing, this current being in-

duced by the action of the main fan. Just below the main fan is located a smaller fan through the hub of the main fan and the air which goes between the motor and casing surrounding the motor is discharged over the hub of the fan so that no great quantity of heat is transmitted to the shaft. The lead wires to the motor pass through one of the two tubes connecting the casing which encloses the motor with the fan casing proper. Care has been taken that none of the motor parts comes in contact with the hot gases or metal parts heated by the gases.

The advantages claimed for this device are that it can be operated with much less noise and dirt; a more constant draft is induced due to being less subject to line fluctuations; the cost of firing up a locomotive is reduced and the work is done in much less time. It has been thoroughly tested in an enginehouse under normal conditions which tests showed a saving of 15½ min. to get up 65 lb. steam pressure from cold water. A saving of 92½ per cent in the cost of firing up a locomotive was shown by the tests.

Whiting screw-type electric drop table

THE screw-type electric drop table shown in the illustrations may be designed to perform any dropping operation on locomotives or cars. In dropping locomotive drivers, it is not necessary to take the locomotive weight on the jacks before starting as the table has a capacity of 50 tons. Neither is it necessary to spot the locomotive closely as the entire rail section drops. As there are no heavy rail beams to be moved out of the way, only a mechanic and helper are needed to do the work. In replacing the drivers with a drop pit, they are first replaced, the rail beams moved in place and the scaffold erected. With the drop table, the operator can stand in the table pit and come up with the drivers. The shoes can be placed first and held by shims. The pedestal binders may be set on blocks and fitted with wedges. In this way all the operations can be performed at once, thus saving considerable time.

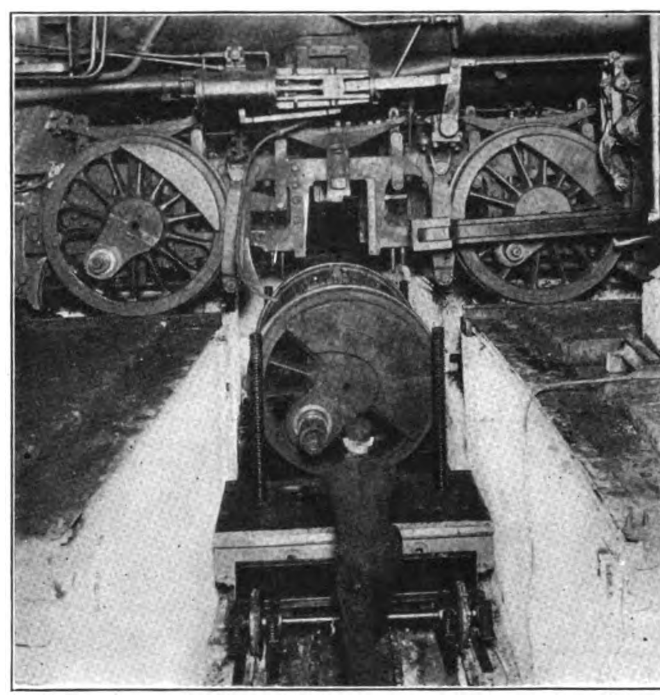


Truck wheels on the table ready to be dropped

If of sufficient length, a complete four-wheel engine or tender truck can be dropped in a single operation. On the other hand, a single pair of tender wheels can be removed by running them out on the table and blocking under the spring seat. If there is a cradle casting on the trailer, it can be blocked on the table and dropped without using extra blocks and tackle.

Boosters are readily removed on the drop table. This is a very difficult operation on a drop pit jack on account of the shifting weight, due to the overhanging weight of the booster engine and the spring weight, which drops to zero after a few inches. As the drop table has four legs any shifting of weight does not affect it.

Spring work can be done quickly and easily without disturbing any box packing. To renew a spring, the table is raised 2 in. above the rail and the spring rigging blocked. The table is then dropped, relieving the weight off the spring. It can then be readily renewed. The same method can be employed in spring equalization.



The main driving wheels of a Mikado removed and lowered to the bottom of the pit on the drop pit table

The drop table consists essentially of a truck with four stationary screws, the table being built on top. Wheels and axles are provided at each end of the truck, being inserted in roller bearings to permit easy lateral movement. The boxes are spring supported so that, when the full locomotive weight is received, the springs will deflect. This in turn seats the screws on the rail, passing the weight directly onto the foundation.

The table rails are reinforced and supported by beams, the load being carried by means of transverse channels to the driving units, which consist of screws and worm wheels with roller thrust bearings. The latter are 14 in.

in diameter and contain 56 rollers. The driving motor is mounted on the table. The control is a matter of choice, the push button types with extension cord being the most flexible.

The pit is rectangular in cross section and may be constructed straight or in conformity with the enginehouse circle. Channels are set in the wall to guide the table and to insure its being correctly positioned. Sockets are provided for the power plug. Only ordinary drainage is required, as there is nothing of a hydraulic nature about the drop table.

As the locomotive is run onto the table, the live load is taken on the locking bars, situated just under the table rail. The power is then turned on and the table run up until the weight is relieved from the locking bars. These bars are then thrown out, a single lever performing the operation. The table and load are then dropped to the low position. The table is then moved laterally by ratchets and after being moved laterally is again raised to the surface. The reverse movement is made likewise.

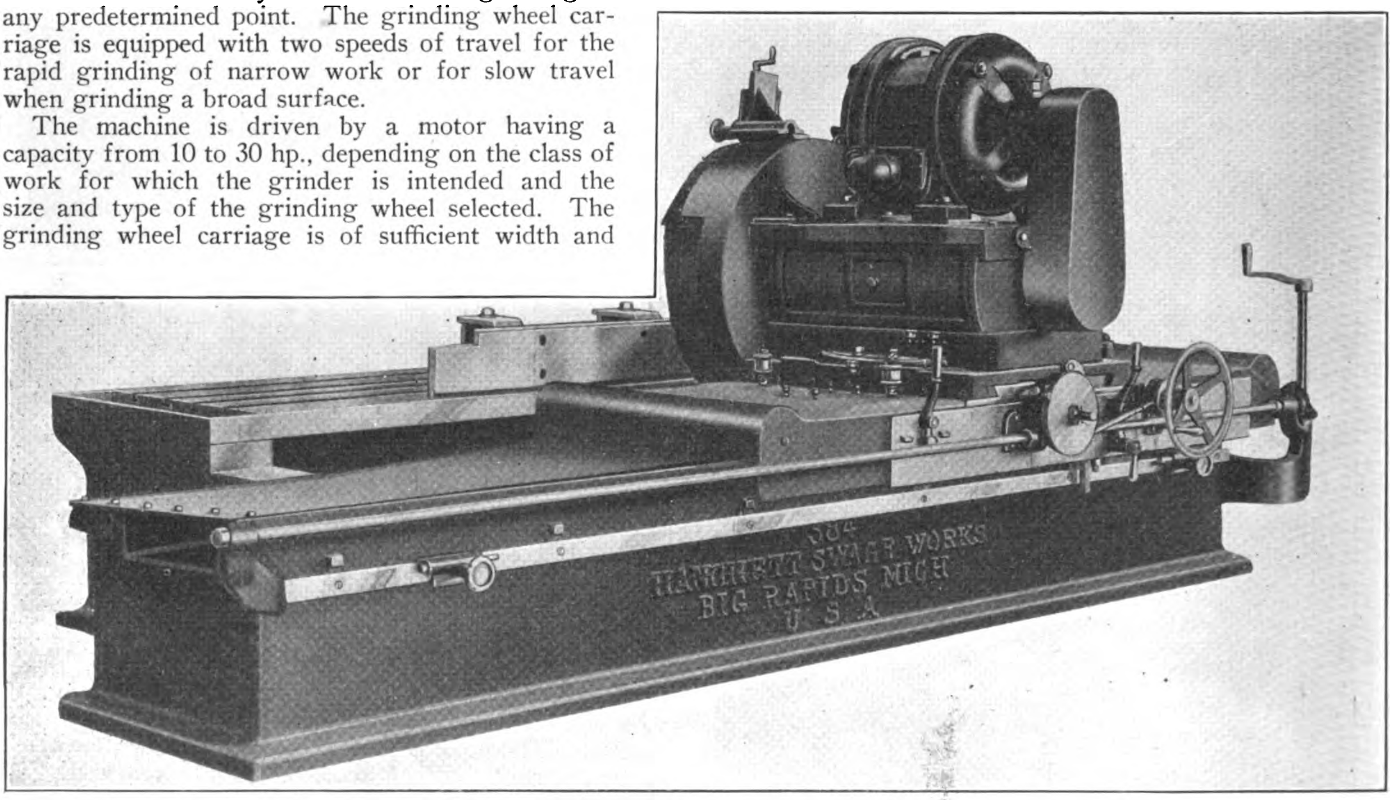
The minimum table length is about 6 ft. 8 in. and the maximum is somewhat indefinite, being controlled by practical considerations. A 10-ft. 6-in. table is capable of handling practically everything. The minimum net table thickness for an integral table is about 2 ft. 1 in. This added to the required drop gives the pit depth. Thus a drop of 6 ft. would require a pit depth of 8 ft. 1 in. The overall width varies with different designs. This equipment is manufactured by the Whiting Corporation, Harvey, Ill.

Cabinet base traveling wheel grinder

THE grinding machine shown in the illustration has a capacity for handling locomotive guide bars, knives, shear blades and general surfacing. The machine is fully automatic, adjustable for any speed of grinding and to feed the grinding wheel to the work at any speed desired, with an automatic stop and graduated dial which can readily be set to cease grinding at any predetermined point. The grinding wheel carriage is equipped with two speeds of travel for the rapid grinding of narrow work or for slow travel when grinding a broad surface.

The machine is driven by a motor having a capacity from 10 to 30 hp., depending on the class of work for which the grinder is intended and the size and type of the grinding wheel selected. The grinding wheel carriage is of sufficient width and length to prevent vibration and is operated by a silent chain and gear drive from the motor arbor, through steel gears completely enclosed in the base of the carriage and running in oil. The pump for the cooling solution is driven by a belt from the grinding wheel arbor and is held in position by sliding ways which are adjustable by a hand wheel to keep the belt at the proper tension.

The machine is equipped with a knife bar for ordinary knife grinding with a magnetic chuck, a flat platen for holding various classes of work and with revolving work holders on which one setting of the work up to full capacity of the machine—in units up to approximately half of the machine capacity—can be placed in position while another setting is being ground, thus keeping the machine in nearly continuous operation without the usual intervals for putting on and taking off work while the machine is idle. A knife bar supplied with two faces with different lengthwise or crosswise slots adapts the one bar for a variety of work. It is adjustable by a worm and gear to hold the work at any desired angle or in a vertical or horizontal plane, and when set can be locked in position. The machine is equipped with a wooden shelf or loading table level with the knife bar on which knives or shear blades can be loaded and then moved over to the bar without danger of injury of loading directly onto the iron bar. The grinding wheel carriage, in addition to the automatic feed



Grinding machine which will handle locomotive guide bars

to the work, can be rapidly withdrawn from the knife bar by a large hand wheel control to facilitate putting on or taking off work. The machine illustrated has a capacity of 84 in. and weighs approximately 11,000 lb. crated.

This machine is manufactured by the Machinery Company of America, Big Rapids, Mich.

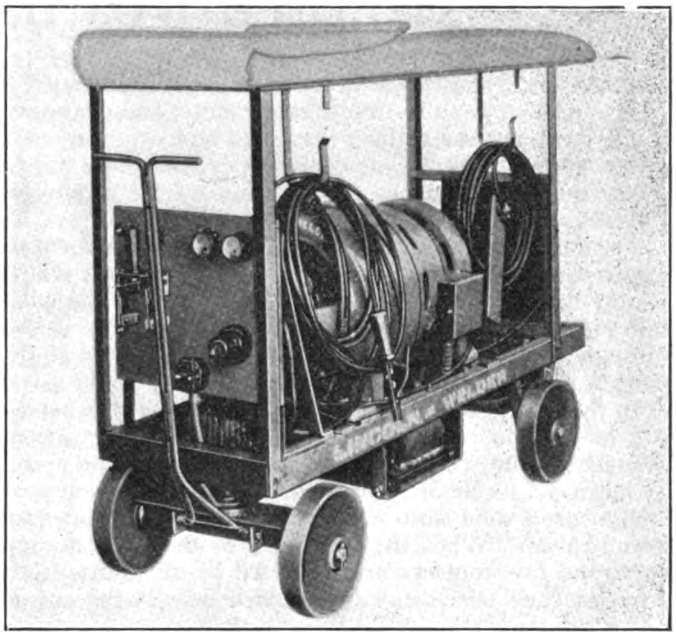
Electric welder designed for railroad shops

An electric welder especially designed for use in railroad shops has been placed on the market by the Lincoln Electric Company, Cleveland, Ohio. The equipment is said to afford unusual ease of operation and to be especially well adapted to its particular field because of its relatively narrow width. It is 21 in. wide so that it will easily pass through the narrowest aisles in a shop. It is fully equipped with large roller bearings which add to its ease of mobility.

The center of gravity of the machine is low so that it will not be liable to tip over. The frame is of structural steel, extending beyond the equipment on the truck, so that it is almost impossible to back the truck into anything which would damage the welder. This is a desirable feature owing to the rough handling equipment of this nature receives in the railroad shop.

The welder, which is a 300-amp. arc unit, uses the stable arc. This arc will weld such jobs as locomotive frames, crosshead guides, truck sides, main driving wheels, journal boxes, etc. It is said that in actual tests, from four to five feet of fire-box seam has been welded in an hour; and that from seven to ten pounds of metal has been placed on a crosshead guide in one hour.

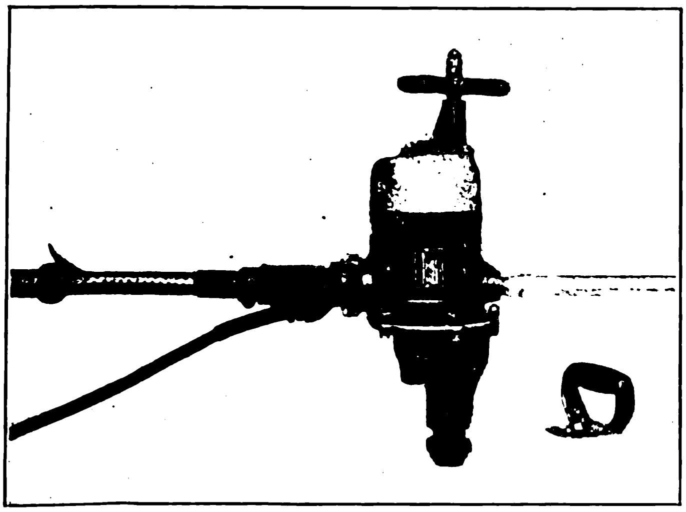
The machine is provided with water-proof covers, which can be thrown back easily and which, when dropped down, provide complete protection from the weather. A push button starter, tool box, handy but out of the way, a spring controlled handle which is out of the way when not in use, convenient cable hooks, and light total weight are some of the other features of this equipment.



Portable electric welder which can readily pass through the congested shop owing to its restricted width

An electric drill and reamer for the car shop

A direct current, compound electric drill and reamer for use in car repair work has recently been placed on the market by the Independent Pneumatic Tool Company, Chicago. It has a drilling capacity up to 1¼ in. and is especially suited for reaming 13/16 in. and 15/16 in. holes in steel car construction work. It has a maximum speed of 600 r.p.m. and weighs 60 lb.



Thor motor driven drill and reamer adaptable for car construction work

Its construction has several features which lend to its adaptability for the work for which it is intended. The one-piece bridge and housing construction of the rear end of the machine provides easy accessibility and also carries the upper armature bearing in permanent alinement with the lower one. The motor is air-cooled through vents in the starter housing. These vents are not drilled radially, but are at a tangent to the fan blade's motion. The rectangular brushes are provided with a liberal area for the maximum of current they carry. The holder, which embraces the brush, draws the heat rapidly away from the commutator surface and spreads it throughout the brush assembly. The radiation, accelerated by the increased air current of the angular vents, carries off the heat from the brushes.

To secure as nearly a perfect balance as possible, first the commutator and fan and then the complete armature are balanced separately so as to eliminate vibration. The commutator is not attached direct to the steel armature shaft because steel does not expand the same under heat as copper. The commutator is a separate unit, built up on a brass sleeve that expands and contracts evenly with the copper segments. Rectangular slots are used on the motor armature which allows the use of more wire and insu-

lation which permits the usage of double silk-covered wires for the coils.

The gears in the motor are machine cut from alloy steel. The roller bearing assembly on the center plate stud provides support for the upper end of the spindle which eliminates strain and wear on the plain bronze spindle bearing at the lower end. The machine is equipped throughout with ball and roller bearings.

The tool is provided with a side handle switch which eliminates all wire connections between the switch handle and the motor. It is a separate unit and makes contact from the motor to the line by means of brass plungers. The cable is of the three-conductor type and leads into the handle through a supporting taper coil spring. A plunger type of switch is used which is located in the handle for the convenience of the operator.

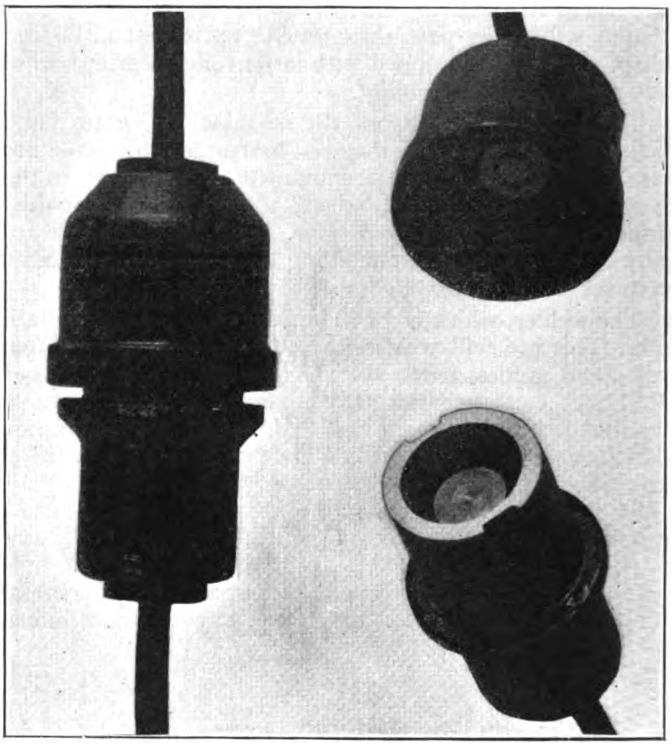
Armored weather-proof connector

A WEATHER proof connector which is intended to make it possible to instantly connect and disconnect with the line without the use of tape or tools, motor driven portable welders or other portable machines has recently been developed by the Ohio Electric & Controller Company, Cleveland, Ohio.

The socket end of the connector should always form the upper part so that any water which may fall on it will be readily drained off and not enter the connector. Asphaltum compound is filled in around the cable where it goes through the insulator so that no water can enter at this point.

In the lower or socket end of the connector, the contact is a loose fit in the insulator and is supported by a compression spring, current being carried around the spring by means of six flexible conductors. This flexible support is to insure a solid electrical contact between the upper and lower halves. When the two parts of the connector are open, the live contacts are protected by the skirt of the armored shell which extends an inch beyond the contact points.

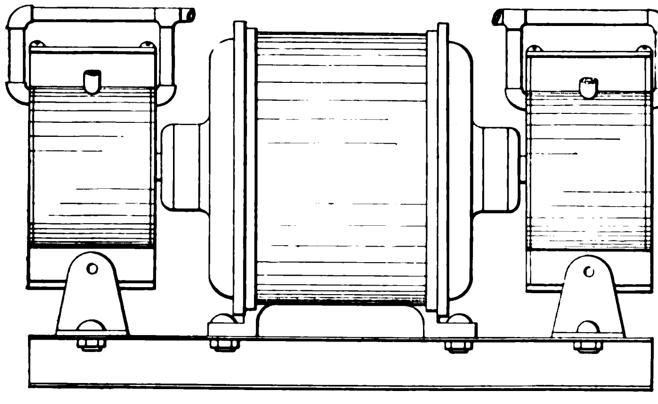
A short piece of No. 4 B. & S. flexible cable is soldered to each end of the connector and, for a short time this cable is capable of carrying 1,000 or 1,200 amperes. The continuous capacity of the connector is 150 amp. which it can carry under test with a rise of 10 deg. C. Intermittent capacity such as would be encountered by a crane motor is 300 amp. It is made only in one size, weighs 3½ lb. and can be furnished as a two or three pole connector when desired.



Weather-proof connector adaptable for motor driven portable machines and cranes

Valveless high speed synchronous air compressor

THE rotary compressor shown in the illustrations is intended for use in pumping fluids or compressing air. Compactness and simplicity of construction are its outstanding features. The ordinary inlet and outlet valves are not used in this machine. An unusual feature is the arrangement of the outlet ports which function as a check valve when they do not register or when the fluid or air is not being discharged from the machine. The operation of the compressor is practically noiseless and for many purposes operative without an air receiver. It is generally motor-driven and unloading devices are unnecessary. An unusual feature is the absence of fly-wheels, pulleys, crankshafts, etc. The rotors function as fly wheels and being located in the casing also function with the casing as suction and discharge valves.

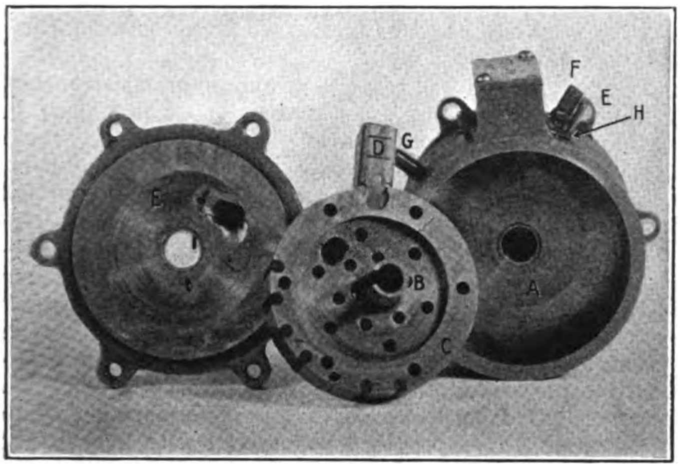


A motor with a rotary air compressor mounted on each end of its armature shaft

The machine was developed by John Milne, 273 Greenwich St., New York. It consists of a cylinder divided into two equal parts by a hollow partition, one face of which is shown at *A*, thereby forming two separate compression chambers. In each of these chambers there is a compressor which is made up of an eccentric or piston *B*, a ring *C* and the sliding partition *D*. The chambers are enclosed between covers *EE*. These compressors are arranged to balance each other, and one may act independently of the other, one being used for compression purposes and the

other for producing a vacuum. The compressed air or fluid from one chamber may be stepped up in the other to any pressure within the limits of compressor practice. One of these double compressors may be mounted on each end of the shaft of one motor, and thus four machines would be compressing at 90 deg. apart. The four units may also be arranged to perform separate functions if desired, two used for air and two for fluid, etc.

In the partition dividing the two chambers of the one machine, there is a cavity in which water or other cooling



Partially disassembled machine showing the piston ring assembled on its piston and the sliding partition *D* mounted in the piston ring

medium is circulated through the pipe shown at *F* and *G*. The shaft of the driving motor enters the bore of piston *B* and is keyed to it. The capacity of the machine is rated as ranging from ¼ cu. ft. to 10,000 cu. ft. and for operation at speeds from 350 to 3,600 r.p.m. for various pressures.

In operation, the rotation of the eccentric piston *B* produces motion of the ring *C* of a combined rotary and reciprocating nature. As the eccentric throws the ring to its maximum position off center, the ring presents the maximum opening between its periphery and the cylinder wall on the right-hand side of the sliding partition. On this side of the partition the cylinder wall carries the intake port *H*. When the rotation continues, the throw of the eccentric carries the ring around in such a manner as gradually to move the widest opening between the ring periphery and the cylinder wall clockwise, until the air or liquid is compressed against the other side of the sliding partition *D*, at which time the port in the eccentric registers with the port in the ring, giving clear outlet to the compressed air or fluid.

The sliding partition has a three-quarter cylindrical bearing in the edge of the ring. As the ring is moved it oscillates in this cylindrical type bearing or hinge and also in its change of position it slides the partition up and down in ways located in the boss on the top of the cylinder. Thus there is always a sealed division between the intake and outlet ports. The numerous small holes shown on the face of the piston and ring are intended to reduce the weight of those parts. The outlet ports in the ring, the piston and the cover register with each other at a predetermined point in each revolution of the piston and ring, and the compressed air or fluid is discharged through these alined or coacting ports at a predetermined point into the outlet in the cover.

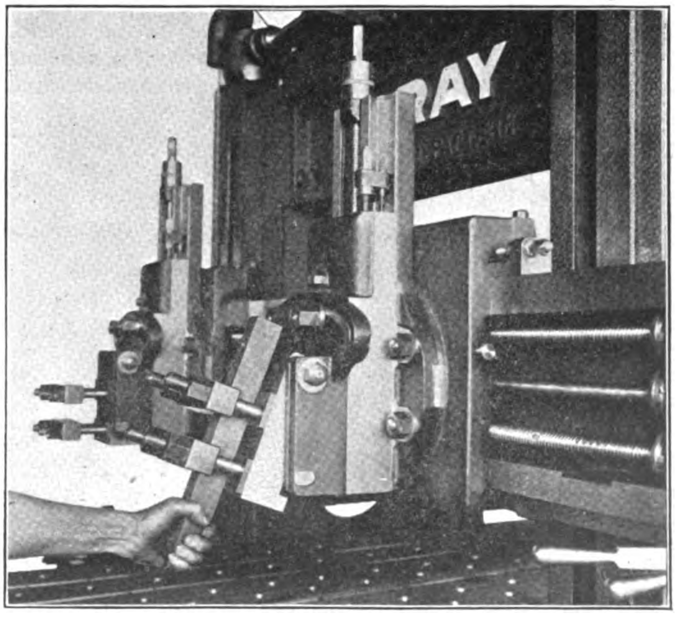
The sliding partition *D* serves only to seal the outlet compartment from the inlet portion of the cylinder. When the outlet ports in the piston ring, piston and cover are not in line, they function as a check valve for the air or fluid in the cylinder and the air or fluid in the outlet piping.

Abutment type apron for Gray planers

The accompanying illustration shows the abutment type apron which is a recent improvement of the Gray planers manufactured by the G. A. Gray Company, Cincinnati, Ohio. This apron consists of a heavy supporting rib running across the bottom of the apron. When the apron drops back in the toolbox, this abutment bears in a finished shoulder on the bottom of the toolbox, so that the tremendous upward thrust of the tool, when taking heavy cuts, comes on this abutment rather than on the taper pin from which the apron is suspended.

This was designed not only to protect the taper pin against excessive wear, but to avoid breakage of the pin or the tool box in case of an accident. Another advantage claimed for it is the fact that it materially stiffens the apron against the tendency to curl up when a heavy clamping pressure is used on the tool clamping bolts.

The head and saddle have also been modified by the application of the twin-purpose taper gib, which is so called because it is used for the dual purpose of taking up for wear and also for clamping the sliding parts rigidly to the stationary parts. The head of the gib is held in place by two shoulders on the clamping screw. This screw has a squared end, so that the operator can apply the usual crank to this screw and with a partial turn force the gib lengthwise between the slide and the harp, thereby wedging it tight over its entire length. Because of the slight angle of the taper gib and the fine pitch of the screw, a considerable clamping pressure can be obtained by only a slight pull on the crank handle. To unclamp, the clamping screw is turned in the opposite direction until the head of the gib is pulled firmly against the cheese-

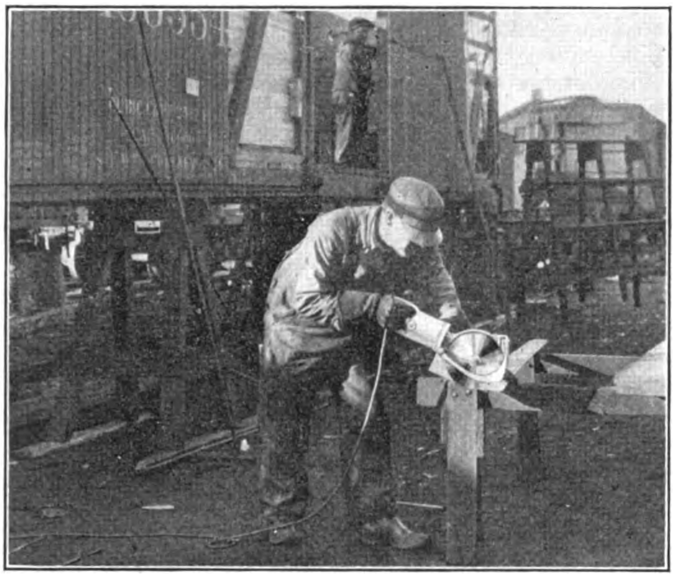


The abutment type apron permits the taking of heavy cuts

head cap screw which limits the upward travel of the gib. This brings the gib back quickly to the running position. As the parts wear the cheese-head cap screw is easily adjusted to change the running position of the gib to compensate for this wear. In cases where the operator wishes to tighten the slide merely enough to take up any tendency to move up and down while cutting, he can easily get the desired adjustment by a partial clamping of the gib. In this application the taper gib is used on a dovetail surface, but the same idea is applicable to ordinary conditions.

Portable electric circular wood saw

A PORTABLE electric circular saw adaptable to trimming car flooring and roofing and suitable for general use about a car shop or repair yard, has recently been developed by the Crowe Manufacturing Corporation, Cincinnati, Ohio.



An electric hand saw for the car man

The body of the tool is made of aluminum which makes it light in weight and easy to handle. Every part is machined and is interchangeable. The smaller size, which weighs 15 lb., has a cutting capacity, with an 8-in. blade, of 2½ in. and the larger size, which weighs 25 lb., with a 12 in. blade, will cut material 4½ in. thick.

The motor used is of the universal type, especially designed for this kind of tool. It can be supplied for either 110 or 220 volts. The saw is equipped with a trigger switch, the purpose of which is to insure safety, as the operator's finger must be held on the switch in order to keep the motor running. The motor fan and shafts are dynamically balanced in order to eliminate vibration while in operation. It is provided throughout with heavy duty ball bearings.

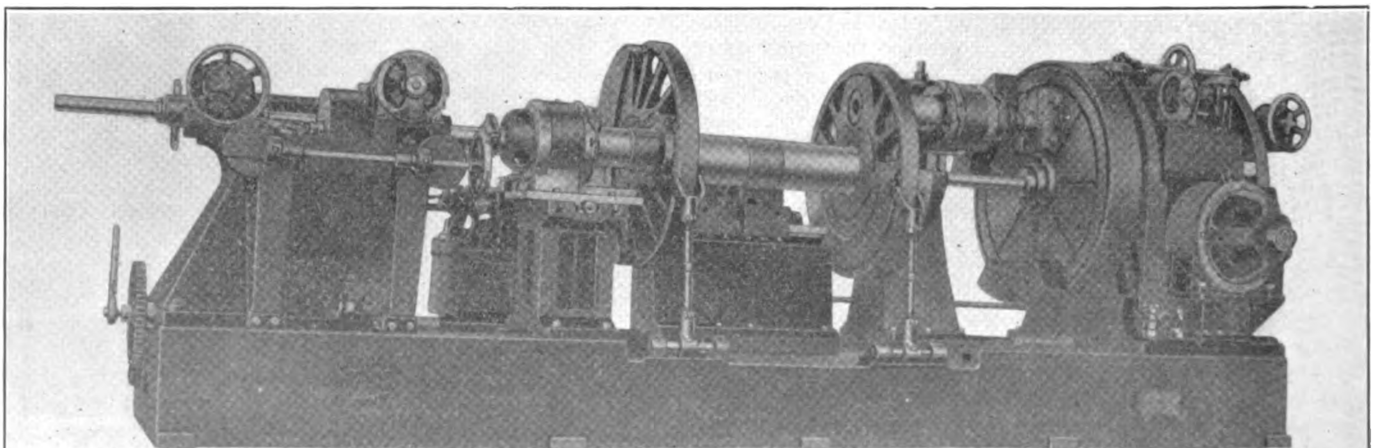
In operation, the front guide is rested flatly on the material to be cut before starting the motor. It is always advisable to keep the cutter away from the material until after the motor is started, then the saw blade is fed into the material, always keeping the finger on the trigger. After the cut is completed, the trigger is released and the tool removed for a new cut.

It is furnished with an electric light extension cord fitted with a plug which fits in any standard light socket.

Journal turning and quartering machine

THE journal turning lathe illustrated has been placed on the market by the Putnam Machine Works of Manning, Maxwell & Moore, Inc., New York, to handle wheel sets up to 86 in. in diameter on the thread. This lathe amply meets all the requirements of a machine of this type; all parts are very liberally proportioned and the various units are particularly convenient of operation.

The drive to the main spindle is by a hardened and ground worm supported on ball bearings, the worm driving a bronze worm wheel mounted directly on the spindle. Both the headstock and the tailstock are adjustable along the bed. A double carriage is mounted in a fixed position



Putnam 90-in. journal turning, quartering and crank pin turning machine, showing the crank pin turning attachment in position

for use on driver sets and a single carriage, arranged so that it may be swung around out of the way, is provided for use on trailer sets.

A faceplate of special construction is mounted on the forward end of the main spindle. The opening in the faceplate is 12 in. in diameter and of sufficient depth to accommodate the largest trailer axles. A pear shaped opening is provided into which the crank pins enter. Two independently adjustable counterweights are fitted to the face of the faceplate, each being provided with a pinion meshing with a gear ring set into the faceplate; adjustment being made by a ratchet wrench placed on the squared end of the pinion shafts. The counterweights are so arranged that any driving wheel set may be balanced and also the counterweights may be placed in balance while turning the trailer journals.

Both head and tailstocks are clamped by two large bolts on the front and two on the back, which engage T-slots in the bed. The bolts are set up by two wedges, actuated by a right and left hand screw, thus equalizing the strain on each bolt. The device is operated from either side of lathe by a ratchet wrench and quickly clamps both the head and the tailstock firmly to the bed. The adjustable spindle in the tailstock carries a ball bearing center, the headstock spindle having a live center. Therefore, no rotation takes place on the machine centers in the center holes of the axles.

The machine can be arranged for either single or double quartering with a capacity for quartering wheels of locomotives with 22 in. to 36 in. stroke.

The crank pin turning attachments are of the sleeve type, the tool slide being mounted on the end of a sleeve which completely surrounds the crank pin and revolves in a large bronze bushed bearing, thus providing rigid support for the tool. Either single or double crank pin turning attachments can be supplied if desired and can be readily removed from the machine when not in use.

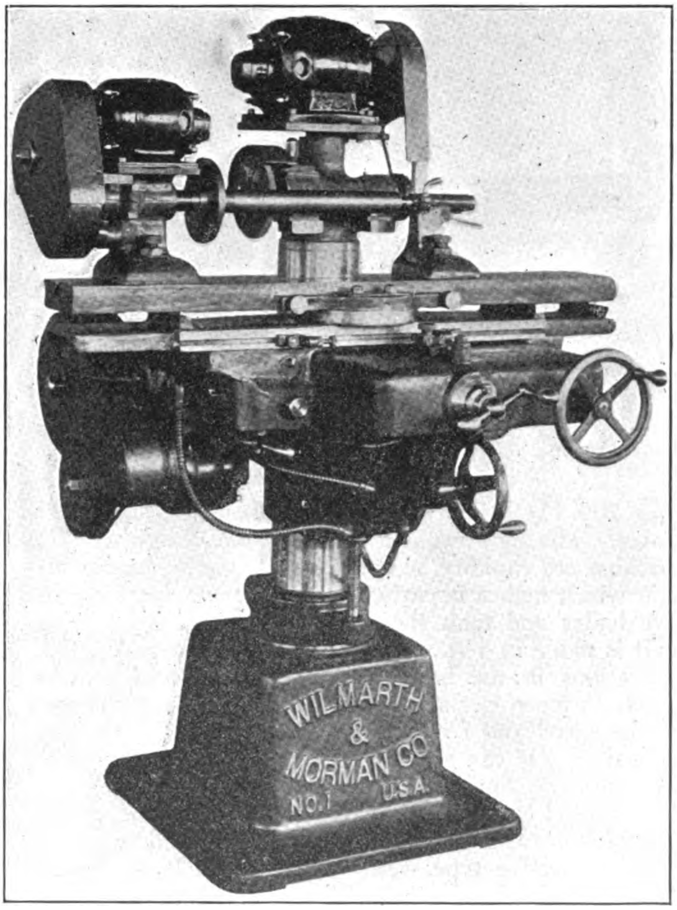
The drive can be either by a 15 hp., constant speed motor, or a 15 hp. adjustable speed direct current motor. The faceplate speeds are from 12 to 36 r.p.m. The longitudinal and cross feeds are 1/32 in., 1/16 in. and 1/8 in. for traversing the headstock and tailstock, two 5 hp., reversing, constant speed motors are required, one mounted inside the bed at each end and geared direct to the traversing screws. The quartering attachments are driven by 3 hp. motors.

Universal cutter and tool grinder

A UNIVERSAL cutter and tool grinder suitable for service in the tool room of a railroad shop has recently been placed on the market by the Wilmarth & Morman Company, Grand Rapids, Mich. The machine is motor driven and is designed for such work as facing milling cutters, grinding the blades of taper reamers, grinding cutters, hobs, etc., face and cylindrical grinding and is also provided with an attachment for internal grinding. Spindle extensions are furnished with the machine which makes it convenient to do surface grinding within the capacity of the machine.

It is mounted on a base 24 in. square, which is of sufficiently massive construction so that when the table is at its extreme position, there is no tendency for the machine to tip. The column is so mounted as to become an integral part of the base. It is ground to provide a smooth bearing for the rotation of the outer column or sleeve. The main spindle housing is carried on the top of the column which is also mounted as an integral part. Referring to the illustration, the sleeve or cutter column revolves around the inner column carrying the knee with its elevating screw. After being rotated to the desired position, it is locked by a clamp screw at the base, which draws two wedges together and against the inner column. The faces of these wedges are machined to fit the base of the column so that there is no tendency to score or wear it.

The knee is of unique construction. It has a solid top with a vertical cylindrical section which takes its bearings on the ground surface of the outer column or sleeve. To insure that the knee rises perpendicularly, a large key is mounted in the face of the sleeve and the keyway is planed in the knee. The keyway is provided with a take-up gib so that it can be tightened if wear ever causes any looseness. A dust protecting ring makes it impossible for any dust to reach the surface. The saddle carries a web or flange, 4 in. deep all the way round. This design, not only adds strength and rigidity, but aids in eliminating dust and grit from the mechanism. The saddle takes a bearing over the full top of the knee at all times and this bearing is provided with an adjustable gib. The saddle



A universal cutter and tool grinder provided with front and rear controls

bearing for the sub-table is 28 in. long and is provided with a taper take-up gib so that it is easy to maintain.

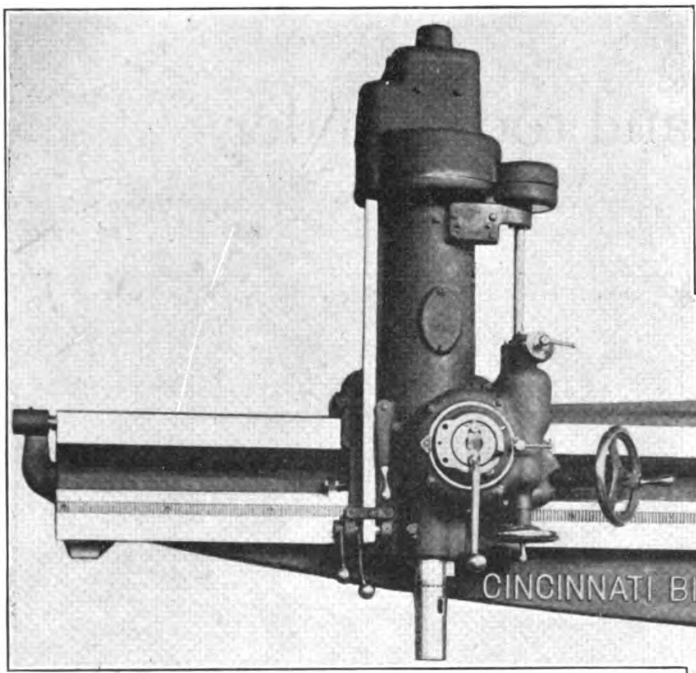
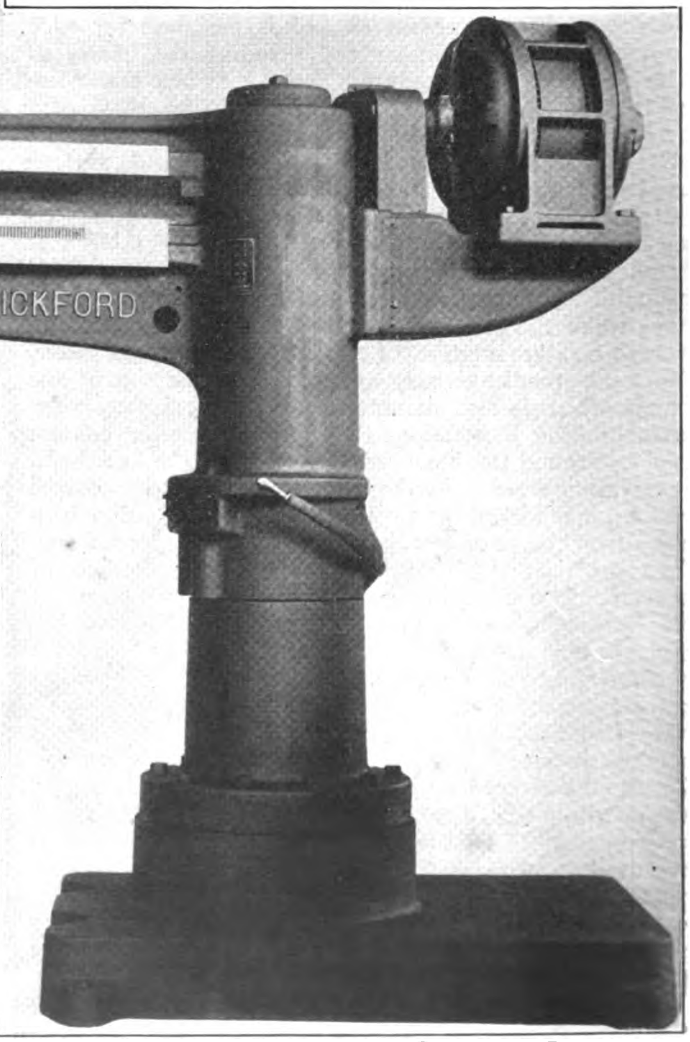
The table and sub-table are heavily ribbed castings, the sub-table being supported in the saddle bearing while the table is supported by the sub-table near the ends. It has one central T-slot.

The longitudinal movement of the table can be operated by either the large hand wheel located at the front of the saddle, or by a lever handle at the rear which imparts a quick travel to the table. Suitable means are provided in both the hand wheel and feed lever for disengaging them, thereby permitting independent operation by the front or rear of the table or by power feed. The cross feed is operated by the ball crank handle on the front of the saddle or by the ball crank handle at the side.

From the description just given, it will be noted that the workman can operate the cross feed, longitudinal feed and vertical movement, without having to change his position in front of the machine. This arrangement is especially convenient when grinding cylindrical work or surface grinding. The additional feature of rear control of all movements gives the operator an opportunity to observe the cutting action of the wheel on the work from the back of the machine.

Heavy type plate and rivet hole driller

A HEAVY plate and rivet hole drilling machine has recently been placed on the market by the Cincinnati-Bickford Tool Company, Cincinnati, Ohio. It is claimed that with this machine one operator can drill over 700 11/16-in. rivet holes per hour through steel plates. The most salient points in the design of this machine are rapidity, simplicity and ease of manipulation which makes it particularly adaptable for locomotive boiler and tank shop work.

Heavy type plate and rivet hole driller provided with a special left hand arm

It is made in 4-ft., 5-ft., 6-ft. and 7-ft. arm lengths. Variations in the base mounting and special attachments to meet special requirements, as well as changes in the speed and feed can be adapted to this machine, if desired. It can also be supplied with a special left-hand arm as shown in one of the illustrations.

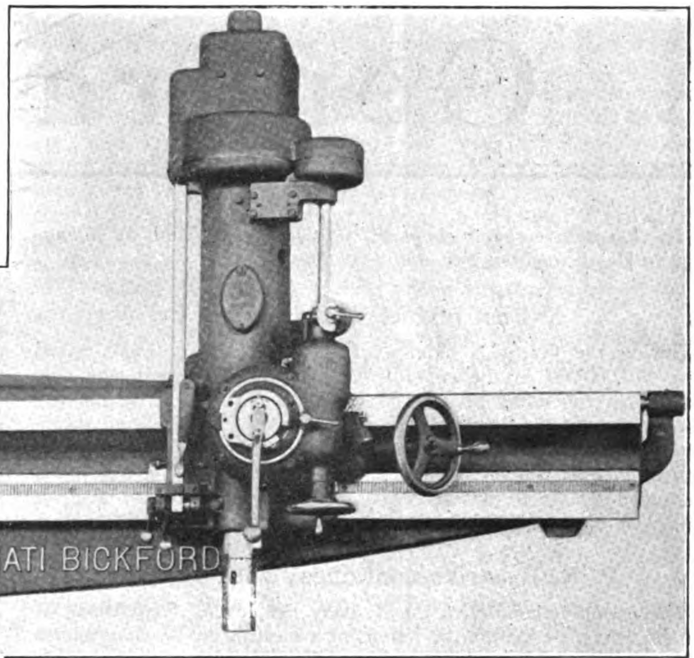
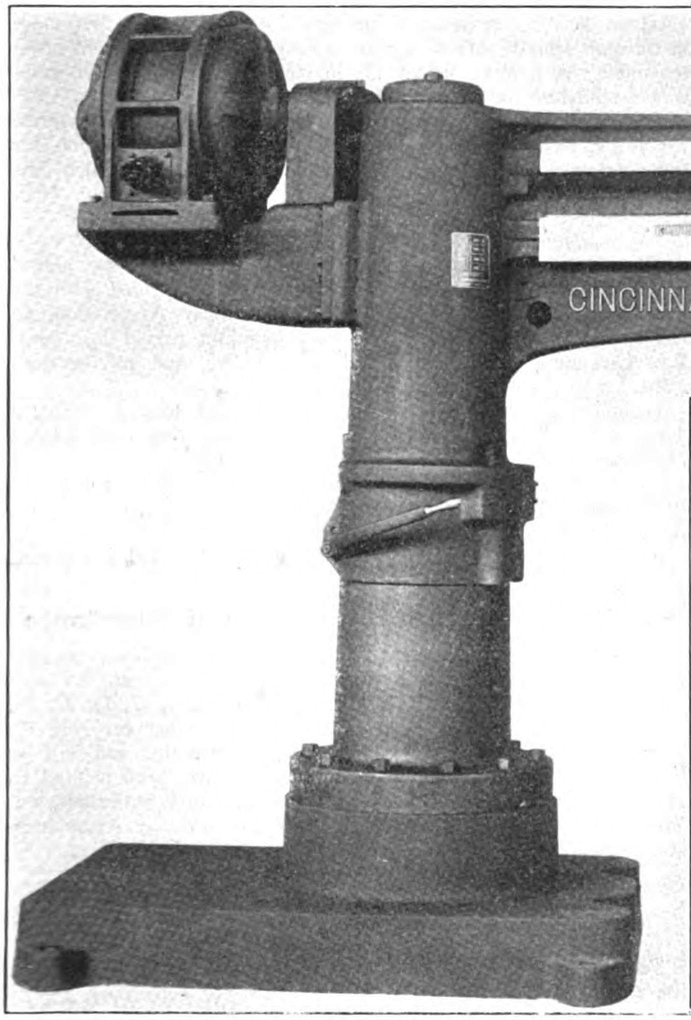
The head contains a quadruple gear shift, the speeds to which are transmitted to hardened steel sliding gear of the selective type. Any speed desired can be instantly obtained by means of levers placed on the lower left side of the head convenient to the operator. The mechanism is fully enclosed and a direct reading dial depth gage and safety stops are provided. The head is gibbed to narrow guides and is well balanced, which affords an easy longitudinal traverse on the frame. It can be clamped without disturbing the attachment for the gib.

The bearing for the spindle sleeve is lapped with cast iron laps. The spindle is made of heat treated alloy steel. This type of spindle was adopted to provide protection for the Morse taper as well as the drift slot in the spindle nose. It is double splined and is provided with both hand and feed rapid advance and return. A long detachable lever can be supplied for special hand feed for use in countersinking holes.

The arm is made in a box section, a design which affords a considerable degree of stiffness. The narrow guide-way is designed to eliminate all possibility of the head rocking sideways. Although the arm is of massive

construction, it can be easily swung in either direction by the operator. The motor is mounted on an extension of the arm behind the column.

The column clamp has a large clamping area for holding the arm and column. This construction prevents any movement of the arm when it is clamped which facilitates the spotting for holes and assists the operator in obtaining maximum production with the

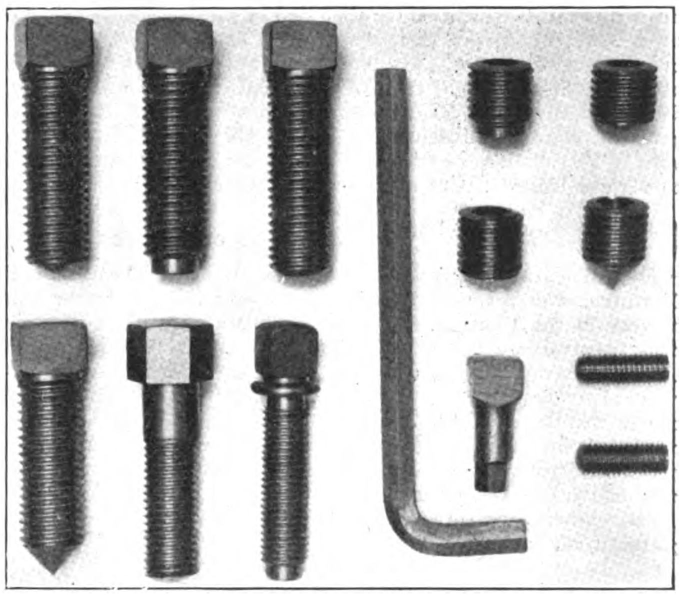



Motor driven drill press with base mountings and special attachments arranged to meet work requirements in the railroad shops

machine under the usual working conditions encountered in locomotive boiler shop work.

Set screws for use on eccentric rods

THE illustration shows a number of square head, hexagon head and hollow set screws that have been designed to provide set screws of considerable torsional strength as well as ability to stand upsetting on the point. These set screws are said to have undergone a number of severe tests before being placed on the market. One of the tests to which the square and hexagon head set screws were subjected was to screw them down into a steel block that had been tapped about two-thirds of the way through. The set screw was then screwed into the block until either the set screw or block failed. In one of these tests the bottom of the hole was pushed out and the other tests resulted in fracturing the block. These screws were also given tension and compression tests. In the case of the hollow set screws, a block of steel was drilled and tapped through and the two screws were tightened against each other by placing one wrench in a vice and tightening the other screw down until either one of the screws or the block



Various styles of square and hexagon head and hollow set screws manufactured by Warren, Killion & Clark

failed. In this test also the block was fractured. These severe tests are made possible by the fact that the set screws are made from a special steel and treated according to a special process. This line of set screws is manufactured by the Warren, Killion & Clark Company, Inc., New York.

THE NEW YORK CENTRAL about April 1, inaugurated the practice of running its passenger locomotives through between Chicago and Buffalo in both directions without change. This run, over a distance of 520 miles, is one of the longest, if not the longest, established with coal burning locomotives.

General News

The locomotive repair shops of the Chicago & Alton at Bloomington, Ill., have been closed for 60 days.

Cost of fuel in February

During the first two months of this year the railroads saved over $10,000,000 in the cost of fuel as compared with the cost for the corresponding period of last year, according to the monthly statement compiled by the Interstate Commerce Commission showing the amount and cost of fuel for road locomotives charged to operating expenses for Class I roads. In February the roads consumed 8,008,539 tons of coal, at an average cost of $2.81 a ton, or a total of $22,501,412, as compared with 9,040,988 tons.

P. R. R. strike continues "with vigor"

The executive counsel of the Railway Employees' Department of the American Federation of Labor, at a meeting in Washington on May 12 and 13, adopted resolutions soliciting "the largest possible support and co-operation of all those who are opposed to industrial tyranny," in behalf of the membership of the six shop crafts formerly employed on the Pennsylvania, whose strike, which began on July 1, 1922, is said to be "continuing with full vigor."

Cars and engines inspected in April

The Bureau of Locomotive Inspection of the Interstate Commerce Commission inspected 6,635 locomotives during April, according to the monthly report of the Interstate Commerce Commission to the President on the condition of railroad equipment. Of these 3,030, or 46 per cent, were found defective and 291 were ordered out of service. The Bureau of Safety during the month inspected 101,037 freight cars, of which 3,002, or 3 per cent, were found defective, and 2,475 passenger cars, of which 23, or 0.9 per cent, were found defective. During the month 12 cases, involving 21 violations of the safety appliance acts, were transmitted to various United States attorneys for prosecution.

A. T. & N. pays bonus to employees

John T. Cochrane, president of the Alabama, Tennessee & Northern, who promised a year ago to give bonuses to the employees in the three principal departments of the road, if each department should show for one year as favorable a percentage of expenses to earnings as in the year then closing, recently announced to the men that the bonus had been earned. This is for the 12 months ending with April, and was payable to men who continued in the service throughout the year. In the transportation department the beneficiaries were the enginemen, trainmen and hostlers; in the mechanical department, all mechanics, boiler washers, apprentices and pumpers; and in the roadway department, all foremen and assistant foremen.

Wage statistics for February

The number of employees reported by Class I railroads for February, 1925, was 1,725,366, a decrease of 2,967, or 0.2 per cent from the number reported for the previous month, according to the Interstate Commerce Commission's monthly bulletin of wage statistics. The total compensation decreased $19,488,816 or 8.0 per cent. This large decrease in compensation is due principally to the fact that there were only 23 working days in February, while January had 26. Compared with the returns for the same month last year, the employment shows a decrease of 1.6 per cent and the total compensation a decrease of 3.1 per cent. There was one more working day in February, 1924, than in February, 1925.

Gulf, Mobile & Northern awards fuel contest prize

The April fuel handicap was the most successful fuel contest ever held by the Gulf, Mobile & Northern. Engineer Frank Armour and Fireman W. J. Johnson on an eight-wheel passenger locomotive took first place in passenger service, using 1,340 lb. of coal per 100 passenger car-miles. Engineer J. E. Stephens and Fireman J. T. Metcalf on a Decapod locomotive took first place in through freight service, using 90 lb. of coal per thousand gross ton-miles. A new record of 122 lb. per thousand gross ton-miles was established for all freight service including locals, and 1,535 lb. per 100 passenger car-miles was established in passenger service for the month. Based on the business and the consumption for the previous month, the company saved over a car of coal a day.

New equipment

Class I railroads during the first three months this year placed in service 44,163 freight cars, according to reports filed with the Car Service Division of the American Railway Association, an increase of 6,511 cars over the corresponding period last year. Box cars numbered 22,665; coal cars, 15,995, and refrigerators 2,384.

Freight cars on order on April 1 this year totaled 46,126, a decrease of 23,172 from 1924. Of these, the box cars totaled 24,434; coal cars, 16,482, and refrigerators 1,933.

Locomotives placed in service during the first three months in 1925 numbered 430, a decrease of 231. Locomotives on order on April 1, 1925, totaled 315 compared with 520.

All of these figures include new, rebuilt and leased equipment.

Supplement published to the Rules of Interchange

A supplement to the current Rules of Interchange has been prepared by the Arbitration Committee of the American Railway Association containing interpretations of rules, 2, 4, 17, 18, 32, 36, 43, 87, 91, 98, 101, 104, 107 and 112, and passenger car rule 10. These supplements are now available for distribution and will be supplied on requisition. A sufficient quantity has been printed to supply one copy for each copy of the Interchange Rules printed. The prices to the members of the American Railway Association are as follows:

100 copies, or more, per hundred	$1.50
50 copies	1.00
Less than 50 copies, each	.03

To other than members of the American Railway Association, the supplements will be sold at six cents per copy. All remittances should be made payable to the American Railway Association, Chicago.

Court News

Charges against former railway shop crafts employees of contempt of court for violation of the injunction against violence in the shopmen's strike in 1922 were dismissed by Federal Judge Claude V. Luse at Superior, Wis., on May 8, according to press reports from that city. The injunction, which was alleged to have been violated, was granted the Chicago, St. Paul, Minneapolis & Omaha on July 20, 1922.

Safety appliance act held not to apply to car inspectors.—The Texas Court of Civil Appeals holds that, while the alinement of a drawhead preparatory to impact is a part of the act of coupling within the federal Safety Appliance Act, the act does not require drawbars to be kept in perfect alinement at all times. They must have some freedom of action to negotiate curves. The statutory duty is to keep them in such alinement and so equipped that they will couple automatically without the necessity of anyone going between the ends of the cars.

It is also held that a car inspector, whose duty it is to discover and repair defects in couplings, cannot recover under the federal act for injuries received in the course of his employment. This appears to be the first case in which the question of the application of the act to car inspectors has been passed upon.—K. C. M. & O. (Tex. Civ. App.), 262 S. W. 520.

Labor Board decisions

Demotion of carpenter foreman not covered by agreement.—A carpenter foreman on the New York, New Haven & Hartford, after three years' service as carpenter and 10 years as carpenter foreman, was demoted and his position assigned to another man, his junior in the service. The explanation offered was that his successor, while employed as a substitute during a vacation period, had demonstrated greater ability as a foreman in that his time books showed a better labor production. This position was contested by the United Brotherhood of Maintenance of Way Employees and Railway Shop Laborers, who contended that the action of the railroad was a discrimination and violation of seniority rights; and after unsatisfactory hearings with the railroads, carried the case before the Labor Board. The carrier's position was that the agreement with the brotherhood nowise covered foremen and contained no provision relating to the working conditions of the foremen. The decision of the board is that in the absence of any rule in the existing agreement governing the case the claim of the employees is denied.—*Decision No.* 3116.

Effect of type of engine on hostlers' compensation.—The Railroad Labor Board has decided that hostlers operating a small standard engine, which was rebuilt with the tank on top of the boiler and the coal space an integral part of the locomotive, used in switching and shifting engines at the roundhouses of the Missouri-Kansas-Texas at Parsons, Kans., shall be paid the engineers' rate for such service. The Labor Board denied the contention of the employees that two days' pay for each day of service is required in view of their contention that the engine is a shop-yard engine and that when hostlers are used to operate it during the course of their assignment as hostlers, they are entitled to not less than a minimum day as a hostler and in addition a minimum day as switch engineer under the engineers' contract. The management contended that the engines could not properly be regarded as yard engines. The management also contended that the shifting, handling and moving of engines in and about the roundhouse and roundhouse zone is work properly coming within the scope of employment of hostlers, that it is wholly immaterial what class of engine is used in the handling of such work.—*Decision No.* 3171.

Shop crafts co-operative plan to be tried on the North Western

A plan for the co-operation of its shops, similar to that first tried on the Baltimore & Ohio, has been approved in an agreement between the Chicago & North Western and the Federated Shop Crafts. The C. & N. W. is the fourth railway to try the experiment, the Canadian National and the Chespeake & Ohio having recently undertaken it.

Under the plan the management and the union agree to co-operate to improve service to the public, to share together any consequent benefit, and to perfect a definite administrative machinery to accomplish these purposes. The agreement reads in part:

"Aside from our mutual interest in the prosperity of the railway, one of the foremost benefits to the employees lies in the stability of employment, and the management is equally interested in the constant and efficient use of its shop facilities. Employees can without doubt bring to the attention of the management many points which will improve local conditions as to methods of planning and handling work in shops and roundhouses on Sundays and holidays and also promotion and co-operative attention to the welfare of the employees. These factors together with the economical use of time and forces, use of tools of the railway in the most advantageous manner, and performance of work by the minimum number of employees consistent with the various classes of work available will aid in the successful operation of the shops and repair facilities."

Conferences are to be held at local points where foremen and other local officers will meet with shop committeemen. It is expected that the first meeting will be held in the shops at Clinton, Iowa. The meetings are to be held on company time with the ranking officer of the railway or his representative acting as chairman of the joint committee. Subjects suggested for consideration are co-operation between departments; proper distribution, storage, and care of materials; increasing efficiency of tools and machines; disposition of scrap; most efficient method of handling engines through the shops; reclamation of usable material; condition of shops and shop grounds and arrangement of car repair tracks and tools. O. S. Beyer, Jr., consulting engineer of the Federated Shop Crafts, who assisted in the inauguration of the plan on the Baltimore & Ohio, will act in a consulting capacity to the union in the operation of the plan on the North Western.

Meetings and Conventions

Annual meeting of the A. S. T. M.

The annual meeting of the American Society for Testing Materials will be held June 23-26 at the Hotel Chalfonte-Haddon Hall, Atlantic City, N. J. Committee meetings will be held on Monday and Tuesday, the regular program opening on the evening of the latter day. The program includes double sessions on the last three days. The day's sessions and subjects are as follows: Tuesday, wrought iron, cast iron and corrosion; Wednesday, nonferrous metals, metallography, ceramics, coal, timber, rubber, slate, presidential address and reports of administrative committees; Thursday, steel and fatigue of metals, road materials, waterproofing, roofing materials, research, testing, nomenclature and specifications; and Friday, paints, textiles, petroleum products, insulating material, cement, lime, gypsum and concrete.

A. S. M. E. nominations

The Nominating Committee of the American Society of Mechanical Engineers at its recent meeting at Milwaukee, Wis., nominated the following officers for the next calendar year: President, William L. Abbott, chief operating engineer, Commonwealth Edison Company, Chicago. Vice-Presidents, A. G. Christie, professor of mechanical engineering, Johns Hopkins Uni-

Freight car repair situation

1924	Number freight cars on line	Cars awaiting repairs: Heavy	Light	Total	Per cent of cars awaiting repairs	Month	Cars repaired: Heavy	Light	Total
January 1	2,279,363	118,653	39,522	158,175	6.9	December	87,758	2,073,280	2,161,038
April 1	2,274,750	125,932	46,815	172,747	7.6	March	77,365	2,213,158	2,290,523
July 1	2,279,826	144,912	49,957	194,869	8.5	June	70,480	1,888,899	1,959,379
October 1	2,304,020	157,455	48,589	206,044	8.9	September	74,295	1,372,277	1,446,572
January 1, 1925	2,293,487	143,962	47,017	190,979	8.3	December	66,615	1,288,635	1,355,250
February 1	2,305,520	139,056	47,483	186,539	8.1	January, 1925	69,084	1,358,308	1,427,392
March 1	2,313,092	141,192	43,855	185,047	8.0	February	66,283	1,313,088	1,379,371
April 1	2,315,732	143,329	43,088	186,417	8.1	March	71,072	1,348,078	1,419,150

Data from Car Service Division Reports.

Locomotive repair situation

Date, 1924	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No req. running repairs	Per cent	Total req. repairs	Per cent
February 1	64,377	53,586	4,116	5,919	9.2	4,872	7.6	10,791	16.8
April 1	64,363	52,805	4,648	6,128	9.5	5,430	8.4	11,558	17.9
July 1	64,416	53,382	7,117	6,035	9.4	4,999	7.7	11,034	17.1
October 1	64,538	53,209	5,424	6,175	9.6	5,154	8.0	11,329	17.6
January 1, 1925	64,384	53,118	4,849	5,927	9.2	5,339	8.3	11,266	17.5
February 1	64,308	52,994	4,220	6,143	9.6	5,171	8.0	11,314	17.6
March 1	64,255	52,851	4,988	6,217	9.7	5,187	8.0	11,404	17.7
April 1	64,230	52,619	6,241	6,345	9.9	5,266	8.2	11,611	18.1

Data from Car Service Division reports.

versity, Baltimore, Md.; William T. Magruder, professor of mechanical engineering, Ohio State University, Columbus, Ohio; Roy V. Wright, managing editor, Railway Age, and editor, *Railway Mechanical Engineer*, New York. Managers, Robert L. Daugherty, professor of mechanical ard hydraulic engineering, California Institute of Technology, Pasadena, Cal.; William Elmer, superintendent, Middle division, Pennsylvania Railroad Company, Altoona, Pa.; Charles E. Gorton, chairman, American Uniform Boiler Law Society, New York. Treasurer, Erik Oberg, editor, Machinery, New York.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Business meeting to be held in Chicago, June 16, 17 and 18. No exhibit of railway supplies and machinery will be held.
DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting September, 1925.
DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention August, 1925, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division. A. F. Steubing, Bradford Corp., 25 West Forty-third Street, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention week of September 14, 1925, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting, June 23-26, Chalfonte-Haddon Hall, Atlantic City, N. J.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 27 to 30, inclusive, Hotel Sherman, Chicago.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt Street, New York, N. Y. Regular meetings second Thursday each month, Hotel Statler, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Annual convention Hotel Sherman, Chicago, September 22-24.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month except July, August and September, at Hotel Cleveland, Public Square, Cleveland.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention, Hotel Winton, Cleveland, Ohio, August 18, 19 and 20.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 6000 Michigan Ave., Chicago, Ill.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Annual convention September 8-11, Hotel Sherman, Chicago.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday each month, except June, July and August at 29 West Thirty-ninth Street, New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in each month, except June, July and August.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth Street, Cleveland, Ohio. Annual meeting September 15-18, 1925, Chicago.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 189 West Madison Street, Chicago. Regular meetings third Monday in each month, except June, July and August.

Supply Trade Notes

The General Piston Ring Company, Indianapolis, Ind., has moved its plant and offices to Tipton, Ind.

The Chicago Pneumatic Tool Company will construct a one-story addition to its plant at Los Angeles, Cal.

The Symington Company has removed its New York office from the Woolworth building to 250 Park avenue.

The Sellers Manufacturing Company, Chicago, will construct a one-story rolling mill 85 ft. by 160 ft. to cost $30,000.

C. F. Moore has been appointed manager of railroad sales of Berry Bros., Detroit, Mich., to succeed E. F. Fisher, resigned.

The Nathan Manufacturing Company has removed its executive offices from 21 East Fortieth street to 250 Park avenue, New York City.

The Standard Steel Car Company and subsidiary companies have removed their offices from 170 Broadway to 120 Broadway, New York City.

The Browning Crane Company is the new name adopted by the Browning Company, Cleveland, Ohio, makers of locomotive cranes and buckets.

C. B. Semple, 104 South Michigan avenue, Chicago, has been appointed Chicago representative of the C. H. Whall Company, Boston, Mass.

The office of William H. Keller, Inc., has been removed from 50 Church street to 54 Dey street, New York City. A. B. Inness is district manager.

The Pennsylvania Car Company plans the construction of a structual steel fabricating unit at its plant at Beaumont, Tex., to cost approximately $90,000.

The Atlas Steel Casting Company, Buffalo, N. Y., has removed its New York sales office from 200 Fifth avenue to 30 East Forty-second street, New York City.

The Harnischfeger Corporation, Milwaukee, Wis., has opened a branch office at 431 First National Bank building, Birmingham, Ala., in charge of James Van Buskirk, who has been transferred from the company's office at Detroit, Mich.

J. L. Price, vice-president and treasurer of the Chicago Pneumatic Tool Company, has been appointed vice-president and general manager of the newly organized Bendix Corporation, Chicago, and president and general manager of the Bendix Brake Company, South Bend, Ind., a subsidiary of the Bendix Corporation.

A. A. Boschert has been appointed sales engineer of the Harnischfeger Corporation, with headquarters at Seattle, Wash., to cover Washington and Oregon. The company has prepared plans for a one-story brick and steel addition, 60 ft. by 88 ft., to the core room of its electric steel foundry in Bay View, Wis.

The Coplan Steel Corporation, Inc., Ogdensburg, N. Y., has completed its plant at Ogdensburg, and is now on a production basis for the supply of chromatic heat resisting steel grate bars. A. H. Coplan is president and Godwin Shenton, vice-president, Ogdensburg. J. H. Burwell, 2708 Grand Central Terminal, is the New York representative.

Charles S. Durkee has been appointed western district sales manager in charge of the sale of stock products in the west and southwest, of J. H. Williams & Co., Buffalo, with headquarters at 117 N. Jefferson street, Chicago, Ill. Mr. Durkee has been with the Williams organization for 18 years and for the past two years was in charge of the central sales district, with headquarters at Buffalo.

Joseph M. Brown, formerly representing the W. F. Hebard Company, Chicago, has entered the sales organization of the Chicago Malleable Castings Company, Chicago, and will be engaged in the promotion of general sales. Guy Bishop, formerly sales representative of the Waugh Equipment Company, has been appointed sales representative of the Chicago Malleable Castings Company, Chicago.

Russell F. Kleinman, Land Title building, Philadelphia, Pa., has been appointed sales representative of the Scott Valve Manufacturing Company, Detroit, Mich. Mr. Kleinman will handle the company's line of valves in Eastern Pennsylvania, Southern New Jersey, Maryland, Delaware and the District of Columbia. The Charles H. Tinker Company, 201 Devonshire street, Boston, Mass., has been appointed New England representative.

An engineering research department to study the requirements for automatic control and other problems in various industries, and an experimental department have been created by the C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y. Victor Wichum, chief engineer, is in charge of the engineering research department, and Frank Bast continues in charge of development work on indicating, recording and controlling instruments. R. M. Wilhelm, formerly of the Bureau of Standards, is in charge of the development of oil-testing instruments. Daniel C. Day is working on some of the more important problems of the users of TAG instruments, under Harvey D. Cooke, general sales manager. William C. Begeebing is in charge of automatic controllers, dial indicating and recording thermometers.

Joseph J. McGarrigle has been appointed eastern manager of the Clark Car Company, succeeding B. K. Mould, resigned. His headquarters are at 52 Vanderbilt avenue, New York City. Mr. McGarrigle graduated in civil and structural engineering from the Pennsylvania State College in the class of 1914. He served in the engineering department of the American Bridge Company until 1916, and then entered the engineering department of the Department of City Transit, Philadelphia, Pa. Mr. McGarrigle served as first lieutenant in the United States Army from July, 1917, until he went to the Midvale Steel & Ordnance Company, car department, general sales, Philadelphia, Pa., in 1919, and when it was merged with the Bethlehem Steel Company he remained in the same department until the time of his joining the Clark Car Company on November 1, 1924.

C. P. Wright, assistant vice-president of the American Brake Shoe & Foundry Company at Chicago, has been promoted to vice-president, with the same headquarters. Mr. Wright was born in Garrett, Ind., on September 12, 1880, and after graduating from high school entered railway service with the Baltimore & Ohio. A year later he entered the employ of the Ansonia Clock Company in Chicago and later the employ of the Chicago Grain Door Company, with the same headquarters. On August 1, 1900, he entered the employ of the Featherstone Foundry & Machine Company, which was absorbed by the American Brake Shoe & Foundry Company. During the past 7 years of his employ with the American Brake Shoe & Foundry Company he has been assistant to the vice-president and assistant vice-president at Chicago.

C. P. Wright

George M. Hogan, secretary and general sales agent of the Sellers Manufacturing Company, with headquarters in Chicago, has been promoted to vice-president, with the same headquarters. He was born in Chicago on October 9, 1883, and received his education in St. Ignatius College, Chicago. He entered the employ of the Sellers Manufacturing Company on August 20, 1906, as a shipping clerk in the plant in Maywood, Ill. He held several positions in the operating and accounting departments in the plant until October 1, 1912, when he entered the sales department as sales agent, with headquarters in Chicago. He held the latter position until April, 1917, when he was promoted to general sales agent, which position he held until January 1, 1918, when he was appointed assistant secretary and general sales agent, with the same headquarters. In February, 1919, he was promoted to secretary and general sales agent.

Trade Publications

PUNCH RIVETERS.—Bulletin R-203, illustrating and describing Hanna rapid punch riveters, has been issued by the Hanna Engineering Works, Chicago.

JACKS.—A safety suggestion concerning all types of double-acting tripping track jacks has been issued in bulletin form by Templeton, Kenly & Co., Ltd., Chicago, Ill.

GRINDING MACHINES.—A few typical jobs as handled by the Heald railroad internal grinder are shown in the pages of a 20-page pamphlet, Bulletin No. 522, issued by the Heald Machine Company, Worcester, Mass.

RIVETERS.—Hanna bull riveters, which are built in sizes ranging from 4 in. to 21 ft. reach, and in capacities from 6 to 150 tons, are described and illustrated in a 36-page bulletin, R-204, recently issued by the Hanna Engineering Works, Chicago.

FLEXIBLE COUPLINGS.—Bulletin No. 35 descriptive of Falk-Bibby flexible couplings has been issued by the Falk Corporation, Milwaukee, Wis. The couplings, designed for every purpose, range in speed from 1/3 to 20,000 h. p. at 100 r. p. m.

ASCO BULLETINS.—"Do your men really know what end ladder clearance is and how to measure it?" is the title of Bulletin No. 4, and "How much money are you losing through non-observance of A. R. A. Rule 86, paragraph 'd'?" are the titles of Bulletins No. 4 and 5 which have recently been issued by the Allegheny Steel Company, Brackenridge, Pa.

BRIDGEPORT PRODUCTS.—Tabulated data, giving the weights, sizes and lengths of Bridgeport products, including brass and copper sheet, rod, wire and shapes, tubing, piping and fabricated articles, are contained in a 48-page booklet, No. 16, which has been issued by the Bridgeport Brass Company, Bridgeport, Conn. Price lists, conversion tables, etc., are also included in the booklet.

TURRET LATHES.—Practical methods for producing turned parts in lots of five to fifteen pieces by the use of machines with standard adjustable tools, are outlined in a 12-page circular, entitled "Profits from small lot production," which has been issued by the Warner & Swasey Company, Cleveland, Ohio. Illustrations show the main points in set-up, and set-up times from actual jobs are given.

FORGED STEEL PIPE FLANGES.—An attractive catalogue of 86 pages, the purpose of which is to place before those who use or specify flanges a complete list of standard forged steel flanges, together with data, descriptions and other information helpful in connection with high pressure piping layouts or pipe fabrications, has been issued by the American Spiral Pipe Works, Chicago. Formulas and data tables embody the new American Engineering standards of 400, 600 and 900 lb. W. S. P., and cover also the existing standards. Full-size cross-sectional drawings show modern practice in the field of increasing pressures and superheat. A section of the catalogue is also devoted to corrugated steel furnaces.

PYROMETERS.—A 56-page catalogue descriptive of indicating, portable and recording pyrometers has been issued by the Republic Flow Meters Company, Chicago. The equipment and methods used in the manufacturing plant of the company are attractively presented in the first few pages of the catalogue. The seven following pages are descriptive of pyrometer applications in the larger industries and contain a full size view showing the upper recording mechanism of the instrument and charts, also a photograph showing the complete accessibility of mechanism. How to select thermo couplers is the subject of the next section of the catalogue, wherein base and rare metal elements and their protection are described and various thermo-couplers and protecting tubes illustrated. The importance of correct interpretation of pyrometer readings, pyrometer maintenance, cold junction errors and how they are eliminated, suppressed zero instruments are the features next taken up. The remaining pages contain specifications and recommended heat treatments for S. A. E. steel, Fahrenheit-Millivolt equivalent charts, a conversion table of Fahrenheit and Centigrade scales and a table of melting points of chemical elements.

Personal Mention

General

C. P. Perot, motive power inspector of the Pennsylvania at Altoona, Pa., has been appointed motive power inspector, office of superintendent of motive power, Southern division.

W. R. Cuttrel, motive power inspector of the Pennsylvania at Altoona, Pa., has been appointed motive power inspector, office of superintendent of motive power, New Jersey division.

R. G. Bennett, superintendent of motive power of the Eastern Ohio division, Central region of the Pennsylvania, has been promoted to general superintendent of motive power of the Southwestern region of the Pennsylvania, with headquarters at St. Louis, Mo., succeeding F. G. Grimshaw. Mr. Bennett was born on March 31, 1882, at Brighton, England, and was graduated from Purdue University in 1908. He entered railway service in January, 1900, as a machinist apprentice on the Pennsylvania, and completed his apprenticeship in 1904. While attending college, Mr. Bennett was employed during summer months as a machinist, draftsman and inspector on the Pennsylvania. In November, 1908, he was appointed motive power inspector. In March, 1912, he was transferred to the maintenance of way department as a rodman; in March, 1913, appointed inspector in the tests department in charge of the locomotive test plant at Altoona, Pa.; in May, 1916, promoted to assistant master mechanic; in February, 1917, promoted to assistant engineer of motive power of the Central division; in July, 1917, appointed master mechanic at Sunbury, Pa., and in May of the following year, transferred to the Pittsburgh division. He was promoted to superintendent of motive power of the Central Pennsylvania division in December, 1919.

R. G. Bennett

O. P. Reese, assistant general superintendent of motive power of the Northwestern region of the Pennsylvania, at Chicago, has been appointed superintendent of motive power of the Eastern Ohio division, Central region, succeeding R. G. Bennett. Mr. Reese was born on May 20, 1876, at Louisville, Ky., and was graduated from Purdue University in 1898. He entered railway service in August, 1898, as an apprentice the Louisville & Nashville, which position he held until September, 1900, when he became a draftsman for the Pennsylvania at Allegheny, Pa. From September, 1900, to September, 1901, he was engaged on special work for that road at Fort Wayne, Ind., and from the latter date to August, 1903, he was a special apprentice. In August, 1903, he became gang foreman at Allegheny, Pa., and held this position until February, 1904. From this time on he held the following positions consecutively: February, 1904, to December, 1904, foreman of tests for the Pennsylvania at the St. Louis World's Fair; December, 1904, to May, 1905, motive power inspector; May, 1905, to May, 1906, general division foreman; June, 1908, to June, 1910, division master mechanic; June, 1910, to September, 1911, assistant engineer of motive power; September, 1911, to May, 1915, master mechanic; May, 1915, to January, 1917, assistant engineer of motive power in the office of the general superintendent of motive power of the same road; January, 1917, to March, 1920, superintendent of motive power of the Central system of the Lines West of Pittsburgh, at Toledo, Ohio; March, 1920, to April, 1921, the same position on the Northern Ohio division. From April, 1921, to February, 1924, Mr. Reese was superintendent of motive power of the Illinois division, and from February, 1924, until his recent promotion, assistant general superintendent of motive power.

O. P. Reese

Master Mechanics and Road Foremen

J. H. Weston, road foreman of engines of the Minnesota division of the Northern Pacific, at Staples, Minn., has been appointed road foreman of engines of the Fargo division, with the same headquarters.

C. W. Adams, whose appointment as master mechanic of the Michigan Central at Jackson, Mich., was announced in the May issue of the *Railway Mechanical Engineer,* was born on March 17, 1885, at St. Thomas, Ont. Mr. Adams received a public and high school education and in September, 1902, entered the employ of the Michigan Central. From 1906 until October, 1920, he served successively as machinist, erecting foreman, roundhouse foreman and general foreman at St. Thomas. He then became superintendent of shops and remained in this position until his appointment as master mechanic as noted above.

Car Department

H. Marsh has been appointed car foreman of the Ashland division of the Chicago & Northwestern, with headquarters at Antigo, Wis.

H. Barrer has been appointed general car foreman of the Galena division of the Chicago & Northwestern, with headquarters at (Wood Street) Chicago.

G. R. Anderson has been appointed district master car builder of the Chicago terminal, Wisconsin, Galena and Southern Illinois divisions of the Chicago & Northwestern, with headquarters at Chicago, succeeding C. J. Nelson, resigned.

J. C. Byrne has been appointed assistant district master car builder of the Chicago terminal, Wisconsin, Galena and Southern Illinois divisions of the Chicago & Northwestern, with headquarters at Chicago, succeeding G. R. Anderson.

Shop and Enginehouse

A. A. Mader has been appointed boiler foreman of the Atchison, Topeka & Santa Fe, with headquarters at Brownwood, Tex.

R. O. Rogers has been appointed night roundhouse foreman of the Atchison, Topeka & Santa Fe, with headquarters at Waynoka, Okla.

M. L. Carlson has been appointed day roundhouse foreman of the Atchison, Topeka & Santa Fe, with headquarters at Waynoka, Okla.

J. Vogel, boiler foreman of the Atchison, Topeka & Santa Fe at Albuquerque, N. M., has been appointed night boiler foreman, with headquarters at Wellington, Kan.

Purchasing and Stores

G. F. Battenfield has been appointed general storekeeper of the St. Louis Southwestern at Tyler, Texas, succeeding F. C. Warren.

F. C. Warren, general storekeeper of the St. Louis Southwestern, with headquarters at Tyler, Texas, has been transferred to Pine Bluff, Ark.

J. W. Taylor, formerly vice-president in charge of purchasing and stores of the Chicago, Milwaukee & St. Paul and, since the receivership, chief purchasing officer, has retired from active service.

Railway Mechanical Engineer

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The spray method of cleaning machinery

In many places, spray guns, similar to those used for painting, are now being used to supplant or supplement the work of the engine wiper and for cleaning all kinds of shop machinery. For cleaning electrical machinery, gasoline is sometimes used as the cleaning agent since it will remove the dirt without injury to the insulation. Probably the greatest objection to the use of gasoline is the fire hazard. Where injury to insulation is not a factor, the fire hazard is eliminated or at least greatly reduced by using an emulsion of water and gasoline. Dirt having a tar content will give way rapidly before a water and gasoline spray. For cleaning the running gear of locomotives, a mixture of water, kerosene and soap is used. The practice of cleaning machinery in this way results in the saving of much labor and in cleaning out-of-the-way places effectively. It will probably be used more widely in the near future and there remains the problem of determining the proper cleaning agent for each application. Different kinds of cleaners are needed and the proper one must be selected for each different application.

How about repair facilities?

Of all the subjects which are reported on by the various committees of the Mechanical Division of the American Railway Association, there is none which touches on a question of much greater importance than that on Locomotive Utilization. The last report of the joint committee and the discussion thereof at the June meeting of the Mechanical Division, an abstract of which will be found on another page in this issue, contains information which is well worth careful study. Operating statistics show that the railroads of this country have handled record-breaking traffic without suffering from a serious motive power shortage. This has been brought about to a great extent by a greater utilization of existing power. In this fact and in the aforementioned report lie a real message to the mechanical department officers, particularly those directly responsible for the operation of engine terminals. One of the big factors in the increased utilization of locomotives has been the extension of runs and the successful application of this operating principle depends upon several factors not the least of which is the maintenance problem. Increased locomotive mileage per day and between shoppings transfers a larger part of the burden of maintenance to the enginehouse repair forces, and because of this fact the master mechanic in charge must be fully alive to the added responsibility—of both organization and facilities. It is not a difficult matter for a wide-awake and progressive man to effect a reorganization of forces that will meet changed conditions. But, how about reorganizing facilities? If the reader happens to be in charge of an engine terminal which has already been, or is liable to be, affected by an operating charge which will tax the existing repair facilities to the utmost, may the suggestion be offered that it might be well to go back and read between the lines of the report and the discussion on "Locomotive Utilization." Therein may possibly be found just the point that is needed to clinch the argument as to why he should have some new machine tools or other facilities to replace those that have been handed down to him.

Effecting better brake performance

The Air Brake Association is an organization dealing with a highly specialized piece of railway equipment, concerning which few, except those who devote their entire time to the subject, can be more than casually informed. This has given the association a high measure of influence as well as a high measure of responsibility. It is interesting to note that during recent years there has been a well defined tendency on the part of this organization to take up actively those subjects bearing directly on the maintenance of air brake equipment in condition to perform its functions effectively and economically, and that in the handling of these subjects there is evident a thoroughness and scientific analysis which is worthy of the consideration of every other organization in the mechanical field. One of the first outstanding pieces of work of this kind was the study of the air consumption of locomotive auxiliary devices which brought to light the tremendous importance of establishing a high standard of maintenance for these pieces of apparatus in order to prevent them from robbing the air brake itself of an adequate supply of compressed air. Even a casual study of the proceedings of this year's convention, an account of which will be found elsewhere in this issue, will show that this association is tackling several problems of maintenance in a way which, when the work is done, will not only have established accurate methods of checking and well defined limits of wear, but will also have presented an array of evidence showing the necessity for the adoption of the standards recommended which will make it impossible for the railroads to ignore the recommendations.

A co-ordinator of departments

The outstanding impression left by the convention of the International Railway Fuel Association, a report of which will be found in this issue, is the wide range of subjects covered, on which papers were contributed by officers of several departments, and the wide range of departmental and group interests represented in the large attendance. The impression was strong that these men had come together not because of a narrow interest in the inside problems of

their own departments, but because of a broad interest in railroading and because of their appreciation of the tremendously important part that fuel plays in railroading. The value of this association, like that of many others in which mechanical department officers are interested, is measured only partially by the permanent value of the committee investigations or individual papers presented and discussed but lies also in the inspiration which comes from the group contact. The inspirational value of the International Railway Fuel Association conventions is particularly important because of the co-ordinating effect it produces in emphasizing the common interest of the various departments in producing a good job of railroading. The opportunity for this kind of co-ordination is undoubtedly greater in the case of this association than in the case of any of the other mechanical department organizations, because they are, by their very purpose, compelled to devote attention primarily to the technical problems of the motive power department or some of its branches. Is there not a possibility, however, for these organizations to get something of the inspiration which comes from a broadened viewpoint by devoting at least a small part of the time of the convention to the consideration of a message from a representative of one or more of the other departments? This is already being accomplished to a certain extent through addresses of executives at the various conventions, but it can be carried even farther to the consideration of papers dealing with some of the problems of common interest between the various departments, of which there are plenty from which to choose.

Wheel Committee favors grinding

With perhaps the prime object of bringing to wheel shop foremen, and particularly mechanics, information which will enable them to understand their work more fully and carry it out more intelligently, the Wheel Committee of the Mechanical Division this year submitted a proposed 100-page Manual on wheel shop practice which holds much of promise for a higher standard and decreased cost of this important work. Considerable space in the committee's report was also devoted to the subject of car wheel grinding, the conclusions strongly supporting contentions of the *Railway Mechanical Engineer* in the past in favor of this method of reclaiming car wheels with slid flat spots and thus at a small cost conditioning them for further service. Without encroaching too much on the findings of the committee, published elsewhere in this issue, it may be said that tests under actual shop conditions showed the average time of grinding a pair of cast iron wheels to be 30 min.; flat spots removed, 3¾ in. long; reduction in diameter on each wheel, ⅛ in.; and total cost, $1.19 per pair. This gave a saving per pair based on second-hand values of $5.31 and, based on new values, of $21.01, figures which indicate plainly the possibilities of economy by grinding slid flat car wheels. Moreover, the tests showed that new car wheels sometimes have a lack of rotundity of 1/32 in. or perhaps more and the treads are more or less rough due to chill marks, both of these conditions being readily overcome by grinding. A pair of new car wheels can be ground in 15 min. or less and assure smooth treads, concentric with the journals, on which there is less tendency for the brakes to stick. The importance of grinding from this point of view is indicated by the number of new car wheels on which the brakes stick and develop flat spots after very brief service. The committee's investigations also extended to the grinding of rolled steel wheels, and a comparison of the cost of turning in a lathe as opposed to grinding gave some highly interesting results. The report showed a reduction in diameter of 1/16 in. by grinding, whereas ⅛ in. was the smallest cut which the lathe tool could take and get under the hardened tread surface, making a total reduction in diameter of ¼ in. The resultant saving in service metal of 3/16 in. in favor of the grinding method was shown in the report to be worth $12.18 per pair of wheels. The important point in connection with car wheel grinding is apparently to select only those wheels in good condition except for the flat spots. Satisfactory results can hardly be expected with wheels already shelled, comby, badly thread-worn or flange-worn.

Why remove the stack?

While sometimes overlooked and seemingly forgotten, the plea for larger and better shop and enginehouse facilities to take care of modern power continues to be heard. In a paper read at the April meeting of the Western Railway Club, Chicago, A. G. Pack, chief inspector of the Bureau of Locomotive Inspection, Interstate Commerce Commission, said, "We find large modern motive power being maintained in the same old shops and with the same old tools that were provided years ago for the lighter equipment. Locomotives, shops and facilities should be modernized if the railroads are to keep abreast with the modern times and render the most efficient and economic service." Examples are not hard to find to substantiate Mr. Pack's statement. At one shop of some importance on a mid-west railroad it was observed that the smoke stack had been removed from one of the locomotives without any apparent cause. The stack seemed to be in good condition; there was no question of interference on the part of the stack which projected into the smoke box. The visitor had already noticed the entire absence of overhead crane facilities in this little old shop with its low roof-supporting timbers and this proved to be the cause of the stack removal. The master mechanic said in explanation, "I have to take the stack off in order to get the locomotive high enough to roll the wheels out from under her." This illustration tells its own story. Not only was there needless labor cost in removing and applying the stack, but the locomotive quite possibly was held in the shop longer than would otherwise have been necessary in order to reapply the stack. Moreover, the morale of the shopmen was bound to be adversely affected. What satisfactory argument or incentive could be offered to shopmen to increase their efficiency and productiveness when they saw wasteful practices permitted by the management of which the instance mentioned was simply an example. Small, poorly-equipped, antiquated and often dirty shops unavoidably mean excessive repair costs.

Mr. Pack also commented on the enginehouse situation as follows: "It is not uncommon to find boilers being washed and extensive repairs being made to locomotives and cars in the most inclement weather out of doors because the equipment has outgrown the housing facilities and in many instances where housing facilities have never been provided. In my opinion, making repairs under such conditions is false economy." Mr. Pack had previously commented favorably regarding the mechanical department officers of today, saying that on the whole they are equal if not superior in skill and ability to any ever employed by the railroads. They have not, however, always been given the support and recognition due them by those in authority. Is not one reason for this the fact that they

have allowed themselves to become so engrossed in the manifold and exacting duties of conducting mechanical department work that they have neglected to show the management just how much antiquated shops and worn-out tools are costing the railroads as compared to modern up-to-date equipment? In other words, have railroad mechanical departments obtained their just proportion of the money spent annually for additions and betterments? Have they not allowed some of this money to go to other departments of the railroads where it would save 10 per cent on the investment when perhaps a saving of 20 per cent could have been obtained by investing it in new shop tools and better facilities for maintaining cars and locomotives?

Interpretations of new Interchange Rule No. 44

The recognized weakness of many of the wood underframe cars, due to decay or other old defects combined with the questionable practice of keeping in service freight cars that are in an advanced state of deterioration, has embroiled the railroads in long and bitter disputes as to who is responsible for the failure of such cars under ordinary handling conditions. Under these conditions a car failure is unquestionably the owner's defect, but the Arbitration Committee of the Mechanical Division, when called on to make a final decision in such disputes is often prevented from correctly placing the responsibility for the damage owing to the impossibility of determining the actual circumstances under which the failure occurs. As a result of these conditions the handling line is often held responsible for damage to cars which should have been charged against the owner. Recognizing the fact that the handling line is entitled to a greater measure of protection than is afforded under the present rule, this year's report of the Arbitration Committee contains a new Rule 44, which definitely points out seven different classes of car failures under ordinary handling which require the handling line to furnish a statement, after a thorough investigation, in order definitely to establish the responsibility of the car owner for the repairs. The committee is to be commended for the inclusion of this new rule in its report as it will not only protect the handling line in the case of failures of badly deteriorated cars but will tend to reduce to a minimum the practice of keeping in service freight cars that are liable to failure under ordinary conditions.

The new rule also provides additional protection to car owners in cases where equipment, in good condition, is damaged in service but cannot be attributed to the provisions of Rule 32. The decisions of the Arbitration Committee have proved many times that it has been bound by the provisions of Rule 32 to charge the car owner with damage to cars which evidence undoubtedly indicated were damaged through too rough usage on the handling lines. Under the new rule if a car, in good condition, fails in any of the ways listed it will be a clear indication that the car has been subjected to unfair usage and the handling line should be held responsible regardless of the fact that the car was not derailed, cornered, side swiped or in a collision.

As a whole, the new rule provides protection for the handling line when passing over its road equipment in a decayed condition and also affords protection to the car owner against being held responsible for damage occurring to its equipment which is in good condition. It should do much to eliminate the constant controversy involved in the interpretation of Rule 32.

What Our Readers Think

Floating bushings have given good results

Greenville, Pa.

To the Editor:

In the April issue of the *Railway Mechanical Engineer*, S. J. Stark asks a question concerning floating main rod butt end and main connection side rod bushings. The following is an answer to his question.

With light locomotives having pins and bushings of small diameter and low tractive force, it often has been quite difficult to keep the main connection side rod bushing tight in the rod and in line with the grease hole below the grease cup. When the bushing keeper bolt was applied in the bottom of the rod it might become lost along the road, making it possible for the bushing to work loose and turn in the rod, thus blankig the grease holes and stopping lubrication, with a consequent hot pin and delay. This difficulty was overcome by drilling and tapping the

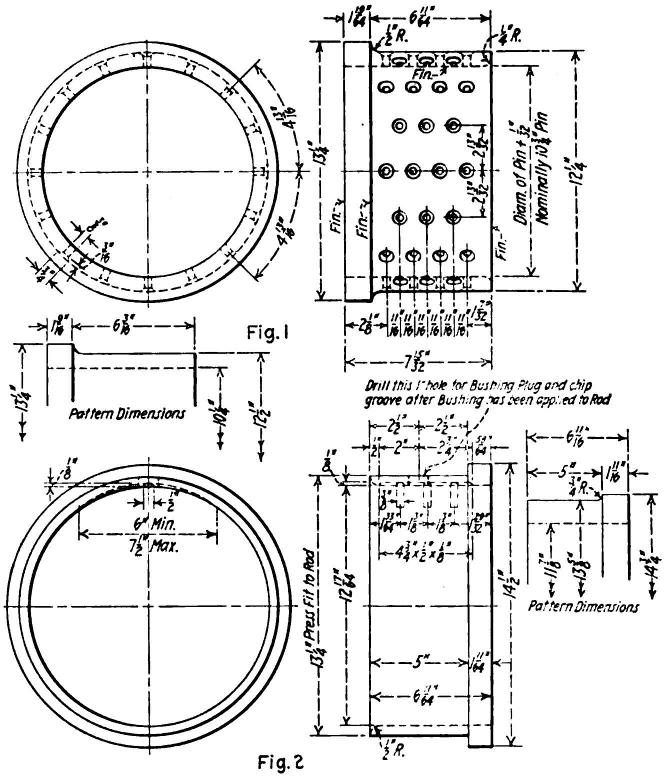


Fig. 1—Main side rod connection floating bushing
Fig. 2—The stationary bushing

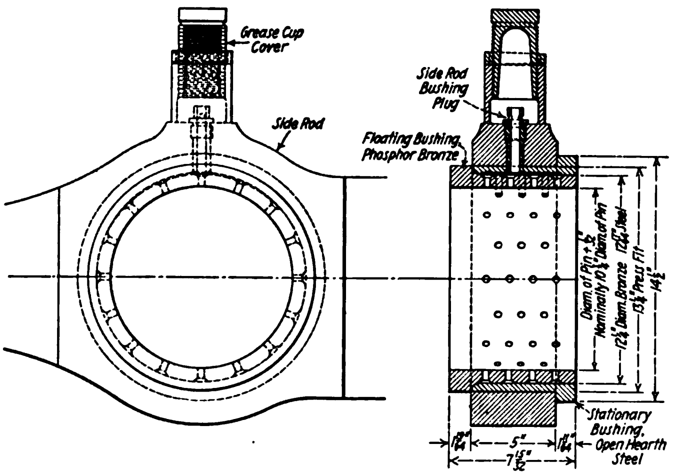
base of the grease cup to take a large diameter hollow bushing keeper. This method, however, produced new difficulties; such as the necessity of drilling out the keeper due to the twisting off of the small head, and on account of the small clearance in the grease cup it also was necessary to have a special wrench to remove the keeper. Even with this method when a large diameter bushing became heated and gripped the pin the leverage of the large diameter pin would shear the keeper at the edge of the hole in the bushing and allow the bushing to turn in the rod, which also shut off lubrication.

The logical conclusion then, since the bushing was

determined to turn, was to allow it to turn, and see that it received correct lubrication. Now, since the brass bushing was to turn in the rod, it would be illogical to allow the resultant wear to occur in the eye of the rod so it became necessary to provide a steel wearing surface by pressing a steel bushing into the rod under heavy pressure and then applying a keeper as a precautionary measure. In equipping existing power with floating bushings it was not considered advisable to increase the diameter of the eye of the rod. This necessitated the designing of the stationary and floating bushing, shown in Figs. 1 and 2, with a combined wall thickness equal to that of the original pressed bushing.

The first class of engines on this road to which experimental bushings were applied was a Santa Fe type having 30-in. by 32-in. cylinders developing a tractive force at 81,600 lb. The main side rod bearing was 10¾-in. inside diameter and the eye of the rod was 13¼-in. in diameter. It was decided to allow the stationary bushing to have ½-in. walls so as to make the wall thickness of the floating bushing of sufficient thickness to fill the remaining space around the pin.

The first experimental bronze floating bushing had two outside circumferential rows with 20 grease holes per row, ¼-in. in diameter, spaced 1⅞-in. on the outside



Drawing showing the arrangement of the main side rod bushing

circumference, staggered and connected inside and outside with zig zag grease grooves. One center circumferential row contained 10¼-in. diameter grease holes. The center circumferential row and zig zag grease grooves were connected on the outside face of the bushing by a machined circumferential groove ½-in. wide and 3/16-in. deep. Operation under service conditions showed that these zig zag grooves provided an easy breaking point for the bushing.

It next was decided to experiment with several parallel circumferential rows of ⅜-in. diameter holes, staggered and countersunk on the outside face of the bushing. Four types of bushings were designed, all having the same wall thickness and the same number of circumferential rows, but having a different number of holes and indicated in the table below.

Style	No. of holes	
1	180	without collar
2	140	with collar
3	72	without collar
4	56	with collar

In order to make a comparative test, several locomotives of the same class were equipped with one type of bushing on the right pin and another type on the left pin. On some engines a similar comparative test, between a new style floating bushing and an old style pressed stationary bushing, was made. After the test in actual service had lasted one year, the following average mileage was shown for the various types of bushings:

Old style pressed bushing	14,000 miles
Zig zag grease grooves with 50 holes	24,902 miles
Style 1	23,565 miles
Style 2	20,041 miles
Style 3	25,158 miles
Style 4	28,640 miles

No further attempt was made to reduce the number of lubricating holes. The floating bushing shown in Figs. 1 and 2 was adopted as standard for this class of locomotives. This bushing had shown an average of 28,640 miles in service, required less machine work, was lubricating properly and was in the best condition at the end of the test. These floating bushings now replace an old style bronze bushing which consisted of a phosphor bronze bearing surface cast inside a gray iron ring.

Material for the old style bushing cost $27.50 while the material for the new combined stationary and floating bushing cost $37.30, an increase of $9.80 or 35 per cent. The machining cost of the new arrangement over the old showed a further increase of 100 per cent for new installations, but this increased cost amounts to only about 25 per cent on bushings applied after the steel bushing is in place. However, to offset these increased first costs we have double the service miles and a greater ease of maintenance in the enginehouse, for with the floating bushing it is not necessary to remove the side rod in order to remove and replace a worn or broken bushing. The saving in enginehouse stall space, labor of replacement, and locomotive service hours more than offsets the additional machining expense.

A clearance between the friction faces of the stationary and floating bushings of 1/64-in. is considered sufficient on lighter power, but on the heavier classes of engines this should be slightly increased, for on these engines the floating bushing with close clearance sometimes heats and binds in the stationary bushing. With an increased clearance the rubbing surfaces remain bright and clear, the bushing rotates easily, and may be removed readily by the enginehouse forces.

From the experience gained from these experiments it was decided to allow just sufficient lubricating holes in future installations, on other classes of power, so that each hole would lubricate approximately 4.35 sq. in. of area on the outside circumference of the floating bushing.

G. Charles Hoey.

Another question about floating bushings

Toledo, Ohio.

To the Editor:

I am writing for information in regards to floating bushings on the back end of main rods. Are they used on switch engines? What method is used to shorten the main rods on this type of locomotive when it is necessary to adjust the length on account of setting up and lining driving box wedges and keying up the front end main rod brasses.

The total piston clearance on most engines is 9/16 in. which leaves 5/16 in. front cylinder head clearance. I find that with solid type back end main rods, on account of both the front and butt end wedges lengthening the rod, it is necessary to watch the clearance closely. This is the reason I would like to know what method is used in keeping the proper clearance with floating bushings.

Sidney H. Kohler,
Shop foreman, Toledo Terminal.

Meeting of A. R. A. Mechanical Division at Chicago

Important reports on locomotive design and construction, design of shops and engine terminals, and car construction

THE 1925 annual meeting of the Mechanical Division, American Railway Association, was held at the Drake Hotel, Chicago, Tuesday, Wednesday and Thursday, June 16, 17 and 18, 1925.

The meetings were called to order at 10 A. M. each morning by J. J. Tatum, general superintendent car department, Baltimore & Ohio, chairman of the Division. The Tuesday session was opened with an invocation by the Rev. Scott R. Hyde, Chicago. This was followed by an address by R. H. Aishton, president of the American Railway Association, and by Chairman Tatum's address, abstracts of which follow:

Chairman Tatum's address

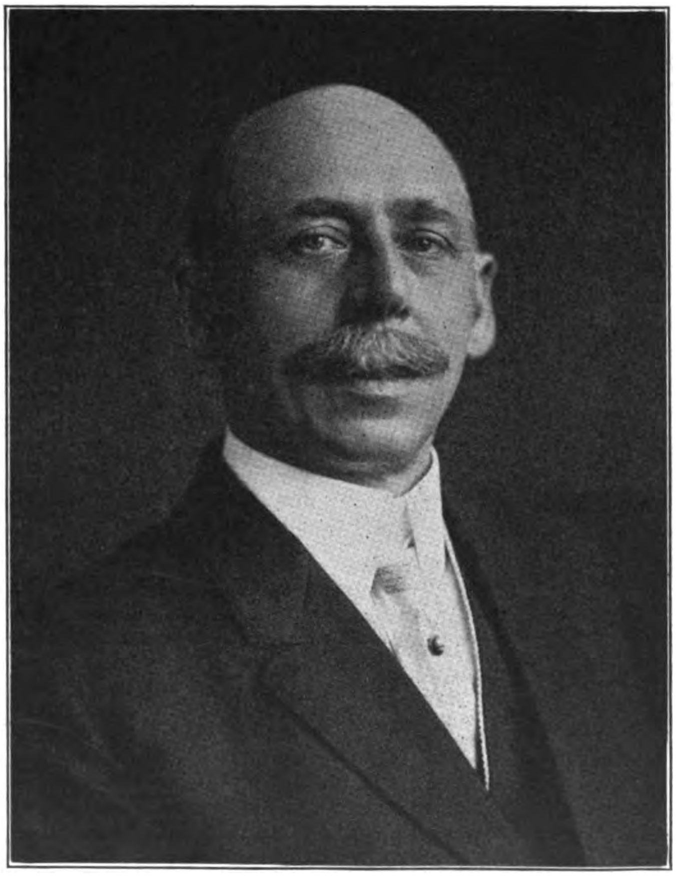
The following is an abstract of Chairman Tatum's address:

The importance of these Mechanical Division conventions cannot be measured and should not be underrated. We should consider the responsibilities resting upon us as members of this great Association.

The proper management of railroad properties affects the investments of over two million stockholders, the greater proportion of them small investors, many of them fellow railroad workers. Railroad securities to the extent of approximately two billion dollars are owned by insurance companies, representing over forty million people. The banks of this nation are holding the savings of its patrons to the extent of seventeen billion dollars, over one billion of which is invested in railroad securities.

To point out further the immensity of our obligations, the statistics of the Labor Board show there are employed in the maintenance of equipment department of all Class I railroads in the United States, as of February 1, 1925, 541,057 employees. In 1924 the expenditures of the maintenance of equipment department of Class I railroads represented $1,270,119,592, or 21.22 per cent of the total operating revenue of $5,986,492,120. In addition to this we are responsible for many of the designs and standards of new locomotive and car equipment on which there is expended yearly many millions of dollars for its purchase.

Our railroads in the past 100 years have been of unparalleled importance in the growth of the United States, when it is considered that during the same period the population of this country has expanded from ten millions to one hundred and ten millions. The wealth of this nation one hundred years ago was less than three billion dollars; today, it is over three hundred billions.


J. J. Tatum
Chairman, Mechanical Division, American Railway Association

Never was there a greater opportunity for the further development of this nation than we have today. Never were the opportunities greater for intelligent, level-headed, hard-working men of high character. Their efforts to manage wisely the accumulated machinery and wealth will not only reflect upon themselves and their dependents, but upon the nation as a whole.

In my opinion the management and economical operation of railroads will depend very materially on the establishment of better understanding and relationship between the public, railroad managements and the workmen. This, I think, can be best brought about by co-operation between the railroad managements and their employees. We must endeavor to understand the employee's side of his relationship with the company as we would have him understand the management's side. As managers we should put ourselves in the workman's place in reasoning out the differences that may exist between us from time to time.

The railroads must be kept in uninterrupted operation. They must provide the service required at all times. This can be accomplished with the peace and good-will of our employees, which is assured when we are willing to co-operate with them and they are willing to co-operate with us. Perhaps the greatest and most effective co-operation can be obtained by having employees become interested in railroad properties to the extent of becoming owners of their stocks. When financially involved we are more conservative in our actions and more interested in the final results than when not so involved. Therefore, if all the employees of railroads were stockholders to a more or less extent there would be a greater assurance of peace and co-operation.

One of the most outstanding reports this year is that of the Committee on Car Construction; the designing of the double-sheathed box car, and the work of the special sub-committee of the Committee on Car Construction in preparing a manual of fundamentals for car design. Another important work was that of the Committee on Wheels. This year they have prepared a manual of wheel shop practices including description of all the different kinds of wheel defects, etc., which they will present.

At the last convention it was thought that we would adopt as recommended practice the all-steel double-sheathed box car. This, however, apparently did not meet with the approval of sufficient members of the association to make this possible. I am pleased to advise, however, notwithstanding the fact that this design of car has not been approved as yet for recommended practice, the Pennsylvania has built 22,000; the Baltimore & Ohio, 2,000; the Read-

ing, 1,000; the Wheeling & Lake Erie, 1,000; the Norfolk & Western, 1,000, and the New York Central, 100—a total of 27,100 cars.

The A. R. A. single-sheathed box car has been approved as recommended practice, and to date I understand the Louisville & Nashville has built 2,500 of these cars; the Southern Pacific, 2,000; and the Missouri Pacific, 2,000—or a total of 6,500 cars. There may be more of which we have no information.

The association approved and has built two double-sheathed wooden box cars, which have been designed during the current year by the Committee on Car Construction.

The most of the work of the association is necessarily borne by a comparatively small number of its members. We need assistance in our annual meetings, conferences and committee work, and I ask that you all contribute a part.

Address of President Aishton

I want to take the opportunity to thank heartily the Mechanical Division, its various chairmen of the General Committee, its present General Committee, the various committees, and the individuals that operate these railroads for what they have done to bring about that result.

Transportation today is adequate. It is reflected in the report I saw in the morning papers from our office at Washington. Take the week before last, which is the last report we have. The railroads of this country loaded and moved 994,874 carloads of freight. Two years ago when we set 1,000,000 cars as the mark, it was the top notch of transportation in this country, and yet week before last, you moved within 5,000 cars of that number at an off season of the year when transportation is not by any means at its maximum, with 300,000 surplus cars and about 7,000 surplus locomotives ready for business when the fall movement comes.

Now, I am no prophet, but I feel confident that no matter what load of transportation is offered to these railways this autumn or in succeeding autumns, there never again is going to be in these United States or in Canada any question as to the ability of the railroads to furnish adequate, prompt, and proper transportation for whatever may be offered. We have made some estimates, and I would not be surprised this fall to see all previous marks surpassed.

There has been a change in the commodities that are being handled. There has also been a change in the distances they have been hauled. The furnishing of adequate transportation has brought about a profound change in the industrial relations of this country. Where it used to be that a man would figure on delays in transportation and stock up for weeks and months in advance, today dealers and shippers are purchasing on the basis of adequate transportation. Adequate transportation has brought about another result, and that is in the amount of capital tied up in goods in transit. The shortening of the time that goods are in the hands of the railroads has brought about very much lower rates on capital and is one of the prime reasons why today money is cheap in this country.

I had a shining example of that just the other day. A man came in to see me, and said, "I don't hand the railroads a bouquet very often, but I think it is due them that I tell you." His company ships ore from Butte, Montana, and Bisbee, Arizona, down on the eastern seaboard. He said, "We recently had to ship a lot of concentrated copper ore down there by rail. We kept an accurate tab on about 500 carloads, and it was on the road only thirteen days." He said, and this is the significant thing, "It has entirely revolutionized our way of doing business. We used to keep big stock piles. Today we are making our shipments according to our daily requirements with the absolute knowledge that that material will be delivered to us as it is needed. The saving we make on interest charges on that copper ore, which is very valuable, alone goes a material way toward paying the freight charges."

There is another side, however, that is not so satisfactory. The work your Division, all the other Divisions of the Association and the individual railroads are doing has been and should continue to be to produce the largest economics that are possible in the operation of these railroads. In other words, keep your eyes and ears open. If you see or hear of a better way of doing a thing, go after it, because one of the great question in the public mind today, and that will be prominent at the national capital in the next year or year and a half, particularly in connection with the investigation into the question of freight rates, their relation to each other, and their adequacy to produce revenue to attract capital, is the economies and efficiencies in the operation of these railroads. You cannot do any greater work than to put in the hands of your representatives who will have to put their case thoroughly before the people and answer that question, the answer as to whether you, as an organization, and your individual railroads are taking advantage of every known thing that is humanly possible to bring about greater economies.

This is the fifty-eighth annual meeting of the Master Car Builders' Association and the Master Mechanics' Association, and their successor, the Mechanical Division of the American Railway Association. In that 58 years your record has been one of continual accomplishment along lines of economy, safety and efficiency. In 1882 there were 56 different kinds of axles in the equipment of the railroads of this country. Today you have one type with six sizes. That of itself is a tremendous accomplishment. In 1882 there were 58 kinds of journal boxes. At the present time you have only one kind with six sizes. There were 26 kinds of couplers. At the present time you have only one. There were 20 different kinds of brake shoes used on freight cars. At the present time there is only one. In 1882 there were 27 different kinds of brake heads. At the present time there is only one kind.

These are some of the things you have accomplished in simplification and standardization that in the end have brought about the ability of these railroads to move freight at a rate per thousand ton miles materially less than that afforded by any transportation by railroad in the world. I am not going into details as to the other things you have done. What I have recited about these various parts of freight cars is an indication of what has been done in every direction.

Take the specifications for materials. Take this standard car that we have had so much discussion about, and about which some of you have felt disappointment because we have not moved faster. I believe that safety in getting the real answer to that matter lies in the fact that you have not moved faster. That is indicated by the standards that you have already prepared and approved in this Division, and which today are very largely governing the building of new freight equipment.

It is my prediction that the next two or three years are going to see a standard car perfected that in its main requirements as to dimensions is going to govern the building of 90 per cent of the equipment in this country. While your accomplishments in the past have been great, there has been no time when such constructive progress has been made in the work of this Division as in the last two or three years.

You are studying a lot of things which some of you think the American Railway Association ought not to consider. But just consider that there are a lot of people, not railroad people, who get these ideas and somebody has to have the answer for them. Who better can find the proper answer for us than you gentlemen who have spent all your lives in the development of this mechanical machine on the railroad?

You made a splendid showing this last year, with $80,000,000 less expense for maintenance of equipment. Quite a part of that is due to the very large amount of new equipment and the vast capital expenditures made by these railroads. I notice that the railroads last year expended $104,682,000 in new shops, improved shops and improved facilities, to reduce the cost of operation.

That brings us to the point that I have already mentioned that, while the service was adequate, there was one side of the question that was not satisfactory. It has been determined by Congress through the Transportation Act that the railroads are entitled to a reasonable return on the capital invested providing the operation is conducted in an efficient and economical manner. The return in no year since the railroads came from Federal control has reached the amount set under the law by the Interstate Commerce Commission as a fair and reasonable return. That rate today is 5¾ per cent. In the year 1923 the railroads were $99,000,000 short of what is a reasonable return on the capital, as indicated by the tentative valuation as prescribed by the Commission, which is not the value as claimed by the railroads. Last year it was $148,000,000 that they were shy, and in the first three months of this year they were still short $21,000,000 of that reasonable return.

Now, of course, the railroads of the country cannot go on spending money, investing capital indefinitely, unless they receive a fair return—such a return as will attract capital, which in turn will provide more economical and more adequate transportation.

So there never was a time when the work of this Division was any more important to the railroads than the present time, for the

next year or two concentrating on those things which will bring about economies and at the same time maintain the efficiency which you have maintained in the last two or three years.

Outside of the matter of economy there is another important thing you want to keep in mind. We heard a great deal for a number of years about the lack of opportunity for management; that governmental activities were taking the place of individual management. I am not at all sure that in some ways possibly we were not a little at fault in not taking the initiative, and that this lack of initiative on our part encouraged action through some arm of the government that felt it must take the initiative. The government does not want to get into the game, but to prevent their getting into the game you gentlemen have got to function. You have been functioning, and today you have got a standing established with the officers of the government such as you never had in your history. And as long as we keep that way there won't be very much question about the government interfering with your management.

Today, as at no other time, when any question arises in regard to something on the railroads one of the first steps taken is to communicate with your chairman. If they can't get him they get me, and I communicate with Mr. Tatum, or whoever may be chairman.

I love the government. Our government is the greatest government in the world, but I love it best when it is not undertaking to manage the railroad business and I am going to try to keep it from doing so if I can.

Report of the General Committee

The report of the General Committee states that the membership of the division at the present time includes 208 railways, representing 399 memberships in the American Railway Association, and in addition thereto, 190 railroads, associate members of the American Railway Association. These railroads, members and associate members of the American Railway Association, have appointed 999 representatives in the Mechanical Division. In addition, there are 1,065 affiliated members and 142 life members.

In addition to a number of routine matters which are formally mentioned in the report, it calls attention to the work of the Director of Research in charge of the investigation of power brakes and power brake systems, through whom arrangements have been made for complete tests of the various brake equipments offered, on the test rack of the association at Purdue University. Attention is also called to the fact that on a recommendation from the Committee on Couplers and Draft Gear an appropriation for $50,000 has been granted to construct a draft gear testing machine upon which tests of draft gears will be made under the auspices of the association with a view to developing a specification for draft gears.

Life members

The report also contained the following list of members who have been made life members during the past year:

Date joined	Name	Title and railroad
1905	Barclay, F. B.	S. M. P., Illinois Central.
1905	Chidley, Jos.	S. M. P., New York Central.
1905	Deeter, D. H.	M. M., Reading Company.
1905	Dickson, J. G.	S. M. P., Spokane, Portland & Seattle.
1905	Dinan, Arthur	Amarillo, Texas.
1905	Downing, I. S.	G. M. C. B., C. C. C. & St. L.
1905	Eberle, Wm. F.	General foreman, Pennsylvania.
1905	Ferguson, L. B.	S. M. P., Alabama & Vicksburg.
1905	McGoff, J. H.	Mech. supt., A. T. & S. F.
1905	Meister, C. L.	Mech, eng., Atlantic Coast Line.
1905	Mullen, D. J.	S. M. P., C. C. C. & St. Louis.
1905	Robider, W. J.	Fibreboard Co., New York City.
1905	Temple, C. H.	Chief of M. P. and R. S., Canadian Pacific.
1905	Wahlen, John	Superintendent,Springfield Electric Railroad.

Obituaries

Following is a list of the members of whose deaths the secretary has been advised, which was also included in the report of the General Committee:

Name	Title and railroad	Died
Banks, O. L.	Superintendnt, Pullman Company	Apr. 23, 1924
Gallagher, F. S.	Eng., Rolling stock, New York Central	Oct. 26, 1924
Garstang, Wm.	Indianapolis, Ind.	Sept. 12, 1924
Haig, M. H.	M. M., A. T. & S. F.	Nov. 10, 1924
Holder, J. A.	Gen. M. B. M., Seaboard Air Line	Apr. 1, 1925
Howard, J.	S. M. P., New York Central	Mar. 24, 1925
Iffla, A. H.	Asst. loco. supt., United Rys. of Havana	Aug. —, 1921
James, Ed. T.	34 W. Broadway, Mauch Chunk, Pa.	Nov. 3, 1923
Jaynes, R. T.	M. M., Lehigh & Hudson River	
Kalbaugh, I. N.	S. M. P., Coal & Coke	Oct. 13, 1920
Kent, F. S.	G. C. I., Pennsylvania	Jan. 19, 1925
Kileen, G. C.	Gen. supt., So. N. Y. Power & Ry. Corp.	Sept. 21, 1921
Lewis, W. H.	Roanoke, Va	June 4, 1924
Linstrom, C. A.	Chief Engr., P. A. & Mck. R.	Sept. 2, 1921
Littell, C. N.	St. Louis, Mo	Sept. 17, 1924
Lord, Alfred W.	S. M. P., Quincy & Torch Lake	Sept. 15, 1920
Lynn, W. K.	Supt., Gulf & Ship Island	
McBride, B.	M. M., Southern	
Meloy, H. C.	Supt., Elec. Appl., New York Central	Oct. 13, 1921
Moir, G. M.	Asst. Supt. Equip., U. S. Railroad Adm'n.	
Monahan, F. J.	D. M. M., Louisville & Nashville	May 20, 1924
Porth, H. W. L.	M. C. B., Swift Refr. Transit Co.	Mar. 2, 1925
Rae, Clark H.	Asst. Supt. Machy., Louisville & Nashville	Dec. 8, 1923
Randolph, L. S.	Baltimore, Md	Mar. 7, 1922
Reid, Chas. H.	Loco. Engr., N. Y. N. H. & H.	1924
Rogers, W. A.	Supt. Shops, Southern Pacific	Mar. 18, 1925
Sheer, J. M.	East St. Louis, Ill	1922
Sinnott, W.	M. M., Baltimore & Ohio	Jan. 1, 1922
Smith, J. L.	S. M. P. & E., Pitts., Shawmut & Northern	Apr. 15, 1924
Smith, W. A.	Chicago, Ill	
Smith, W. G.	Denver, Colo.	Nov. 3, 1921
Snodgrass, W. C.	Pres., Blakely Southern Railroad	
Thayer, F. C.	G. R. F. E., Southern	Nov. 12, 1924
Thiele, C. F.	C. C. I., Pennsylvania	Apr. 27, 1923
Thomas, R. V.	Supt. Machy., De Queen & Eastern	
Thomas, W. H.	Philadelphia, Pa	Mar. 7, 1914
Walton, E. A.	Franklin, Mass.	June 27, 1922
Weir, Robt.	M. M., E., D. & B. C.	
Westervelt, Jos.	M. C. B., New York Central	
Wightman, D. A.	Warren, R. I.	July 6, 1917
Williams, C. R.	Corning Machine Co.	May 27, 1918
Williams, W. H.	Gen. For., Erie	Mar. 1, 1924
Witt, G.	Lambert Bros. & Wirt	Nov. 6, 1924
Witt, J. G.	M. M., Washington, Idaho & Montana	June, 1923
Woodcock, C. A.	M. M., Caguas Tramway	

The report of the committee was signed by J. J. Tatum (chairman), superintendent car department, B. & O.; J. T. Wallis (vice-chairman), chief motive power, Pennsylvania System; C. F. Giles, superintendent machinery, L. & N.; A. Kearney, superintendent motive power, N. & W.; L. K. Sillcox, general superintendent motive power, C. M. & St. P.; J. Purcell, assistant to vice-president, A. T. & S. F.; C. E. Chambers, superintendent motive power and equipment, Central of New Jersey; C. H. Temple, chief motive power and rolling stock, Canadian Pacific; G. E. Smart, chief car equipment, Canadian National; J. S. Lentz, master car builder, Lehigh Valley; W. J. Tollerton, general superintendent motive power, C. R. I. & P.; J. A. Power, superintendent motive power and machinery, Southern Pacific Lines; O. S. Jackson, superintendent motive power and machinery, Union Pacific; F. H. Hardin, chief engineer motive power and rolling stock, New York Central; W. H. Fetner, chief mechanical officer, Missouri Pacific, and A. R. Ayers, assistant general manager, N. Y. C. & St. L.

Officers elected for the coming year

In electing the officers and members of the General Committee this year, the Rules of Order were suspended and the secretary instructed to cast the ballot of the convention for the candidates proposed by the Nominating Committee. Those elected were as follows:

For Chairman—Term expiring June, 1926:

J. T. Wallis, chief motive power, Pennsylvania System.

For Vice-Chairman—Term expiring June, 1926:

L. K. Sillcox, general superintendent motive power, Chicago, Milwaukee & St. Paul.

For the General Committee—Term expiring June, 1927:

A. R. Ayers, assistant general manager, N. Y. C. & St. L.

W. H. Fetner, chief mechanical officer, Missouri Pacific.

F. H. Hardin, chief engineer, motive power and rolling stock, New York Central.

O. S. Jackson, superintendent motive power and machinery, Union Pacific.

J. S. Lentz, master car builder, Lehigh Valley.

J. A. Power, superintendent motive power and machinery, Southern Pacific Lines in Texas and Louisiana.

W. J. Tollerton, general superintendent motive power, Chicago, Rock Island & Pacific.

To succeed unexpired term of L. K. Sillcox—Term expiring June, 1926:

J. J. Tatum, superintendent car department, Baltimore & Ohio.

The members of the Nominating Committee whose slate was elected are F. W. Brazier (chairman), assistant to general super-

intendent rolling stock, New York Central; H. T. Bentley, general superintendent motive power and machinery, Chicago & North Western; J. J. Hennessey, assistant master car builder, Chicago, Milwaukee & St. Paul; C. E. Chambers, superintendent motive power and equipment, Central of New Jersey; and W. J. Tollerton, general superintendent motive power, Chicago, Rock Island & Pacific.

Report on the design of shops and engine termnials

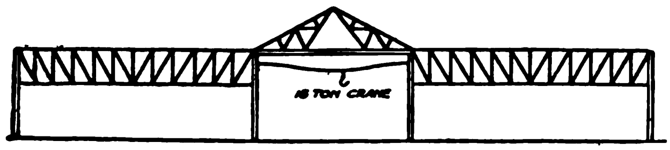
The following report constitutes a study of the design and layout of passenger car repair shops and is presented in response to may recent inquiries to the committee handling this subject for information regarding modern layouts of plants of this nature.

Within the last few years, in all manufacturing plants, much attention has been directed to the routing of the article being manufactured through the various stages and operations necessary to produce the finished article. It has been found that by routing, production is increased and as a result the cost per unit of output is correspondingly decreased. This is the result of:

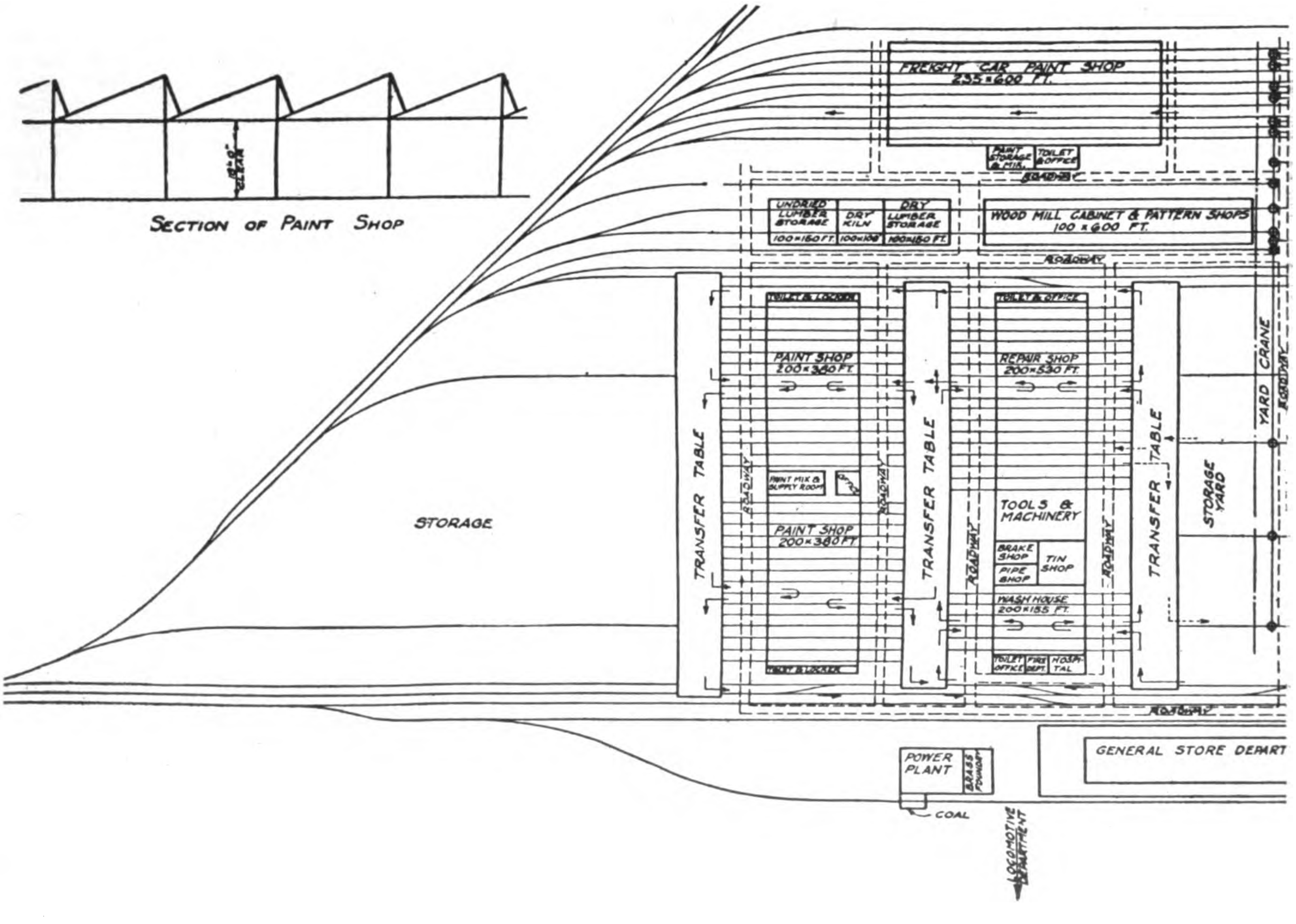
1. Having definite operations for each workman.
2. Reducing waste time of workmen unnecessarily traveling about the shop.
3. Having definite locations for laying down material near the workmen.
4. Moving material by the shortest routes.

The routing systems have perhaps reached their greatest development in the automobile industry. Apparently railway repair shops, in general, have been the last to take up any such system. This is due, perhaps, both to the difficulty of applying such systems to the work of repairing railway equipment, and to the arrangement of most railway plants which are not of recent construction and do not lend themselves easily to routing systems. Even in the more modern shops it does not seem possible to apply a routing system to all classes of repairs. Within recent years, however, the so-called progressive system of freight car repairs has been installed in a number of shops and excellent results have been reported. In canvassing among a number of car shop supervisors it was found that it is almost a unanimous opinion that a modern passenger car repair plant should be designed along the lines of the progressive repair system.

However, in any plan of passenger car shop the progressive system as applied to freight car plants is not equally applicable to passenger car shops, for the reason that it is not convenient to move passenger cars from position to position as is done with freight cars. Nevertheless, it does seem possible to route materials and parts to be repaired from and to passenger cars so as to minimize labor.



SECTION OF REPAIR SHOP



Plan No. 1—A passenger and freight car

In all layouts it is assumed that the cars going into the repair plants will pass in front of or near the electrical shop, plating shop, upholstering shop, and tin shop, and that, when it is most convenient, there will be removed from the cars: the batteries and electrical equipment, plated fixtures, upholstering, water coolers, etc., and these will be sent to the respective shops for repairing. The cars are then moved to the scrub room for interior cleaning. Here the sash, doors, deck screens, etc., are removed and sent to the varnish room for refinishing or, if necessary, to the cabinet shop for repairs. The chairs, tables, and other furniture are handled in the same manner. The cars then proceed to the paint shop or the sand blast building to have the paint removed by burning, or by sand blasting after which they go to the repair shop where all defective parts are repaired.

Upon coming out of the repair shop the cars are passed to the paint shop for refinishing and replacing of sash, doors, furniture, etc., and then move out on a track which is near the track on which they first entered the shop. Here the batteries, upholstering, plated ware, tin ware, etc., are replaced.

Coach repair shop

Coach repair shops are practically all of the transverse track type. The longitudinal track shop can not be used to advantage in repairing passenger train cars. Each transverse track has length sufficient for one or two cars with ample space between them for repairing the ends of the cars.

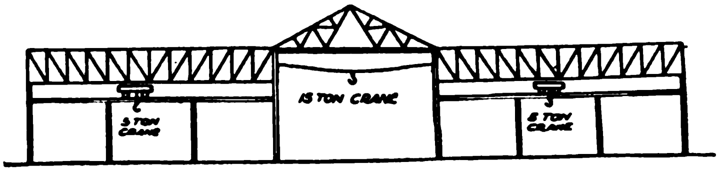
In width the coach repair shop should not be less than the length of the longest coach on the road plus the length of each of the trucks, plus at least a 10-ft. aisle next to the wall and a like aisle between cars in a two car track shop. This will mean a width for a single car track shop of 110 ft. to 150 ft., and for a two car track shop of 220 ft. to 270 ft. The width may be decreased correspondingly if the trucks are not taken into the repair shop, but instead are removed from the cars at a stationary jack on the inbound track. The repair tracks should be spaced at least 24 ft, center to center.

The height from the floor to the bottom chord of the roof trusses should not be less than 22 ft.

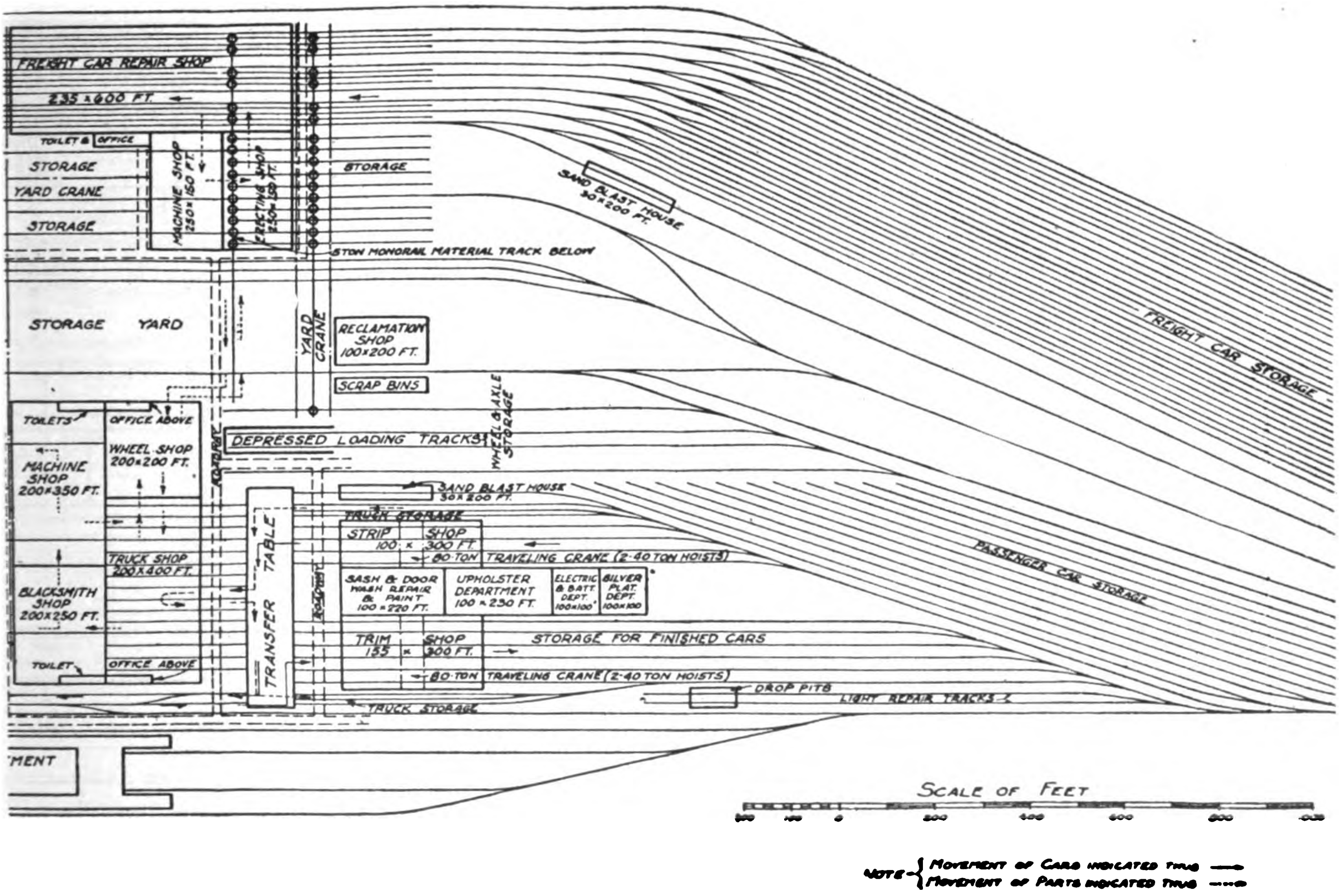
The shop should be piped for water, steam, air, and welding gas, and should be well lighted both by natural light and artificial light. A sufficient number of outlets should be provided for drop cords and for operating electric welding machines and portable motor driven saws, joiners, etc. It is recommended that pipe lines in so far as possible be placed overhead. Underground pipe lines or pipe lines in tunnels are as a rule difficult of access and to repair.

The transfer table should be at least 90 ft. long if the longest modern coaches are handled, and to this should be added the length of the tractor if one is used. The cars are moved either by a cable pulled by a winch on the table or by a tractor. The tractors in use are operated by electric storage batteries or by gasoline motors, and they have either broad treads on the tires for running on platforms and concrete roads or flanged tires for standard gage tracks.

When handling a shop having two car tracks it is recommended



Section of Truck Shop



repair shop proposed for a large railroad

that the transfer table have at least two tracks and if possible three, so that cars can be shifted with a minimum movement of the table. In the case of three tracks two of them are for holding cars from the shop repair tracks and the third is a "run-around" for the tractors.

Truck shop

The truck shop should be located near the repair shop. It is advisable to provide the shop with an overhead traveling crane of at least 15 tons capacity for the shifting of trucks inside of the shop. If the traveling crane is not installed the repair floor should be provided with jib cranes or monorail crane of one and one-half or two tons capacity to assist the workmen in lifting the heavy parts of the trucks.

There should be ample storage space for trucks in the vicinity of the truck shop. In large plants it may be advisable to run the truck shop crane over the truck storage platform. The truck shop should be well lighted and heated and piped for air, gas torches, and electrical welding equipment, and the floor should have a concrete base covered with wood blocks or equivalent.

Wheel shop

The wheel shop should be located adjacent to the truck shop so that mounted wheels can be quickly transferred between the two shops. Also the wheel shop should have about it sufficient storage space for mounted and unmounted wheels and axles, and have depressed tracks for loading and unloading mounted and unmounted wheels.

It is recommended to install traveling crane service over the outside storage platform where the shop is of sufficient size to warrant it. When the crane is provided the depressed tracks are not required. Where one wheel shop is to serve both the freight car and passenger car departments it should be readily accessible to both of these departments.

The pipe shop, air brake shop, machine shop and blacksmith shop should be located close to the coach repair shop. If possible they may be under the same roof as the repair shop and occupy a position similar to that of the machine bay adjacent to the erecting bay in locomotive shops. For securing better light and ventilation it is advisable to locate the blacksmith shop separate from the other buildings, and possibly the machine shop also. These shops should have easy access to a material storage yard provided with racks and bins for pipe, bar iron, steel sheets and steel sections, coal and coke, and other supplies.

Storehouse

The storehouse, or as it is frequently termed the "sub-store" in which are held stocks of bolts, nuts, washers, screws, and also small forgings and castings of all kinds, should be located where men are not required to travel any great distance in reach of it. Even in shops having messenger service where the material men provide the workmen with such materials, much time is saved by having the storehouse close to the repair plant. The storehouse should be provided with an outside material platform and unloading track, and crane service if it can be used to advantage.

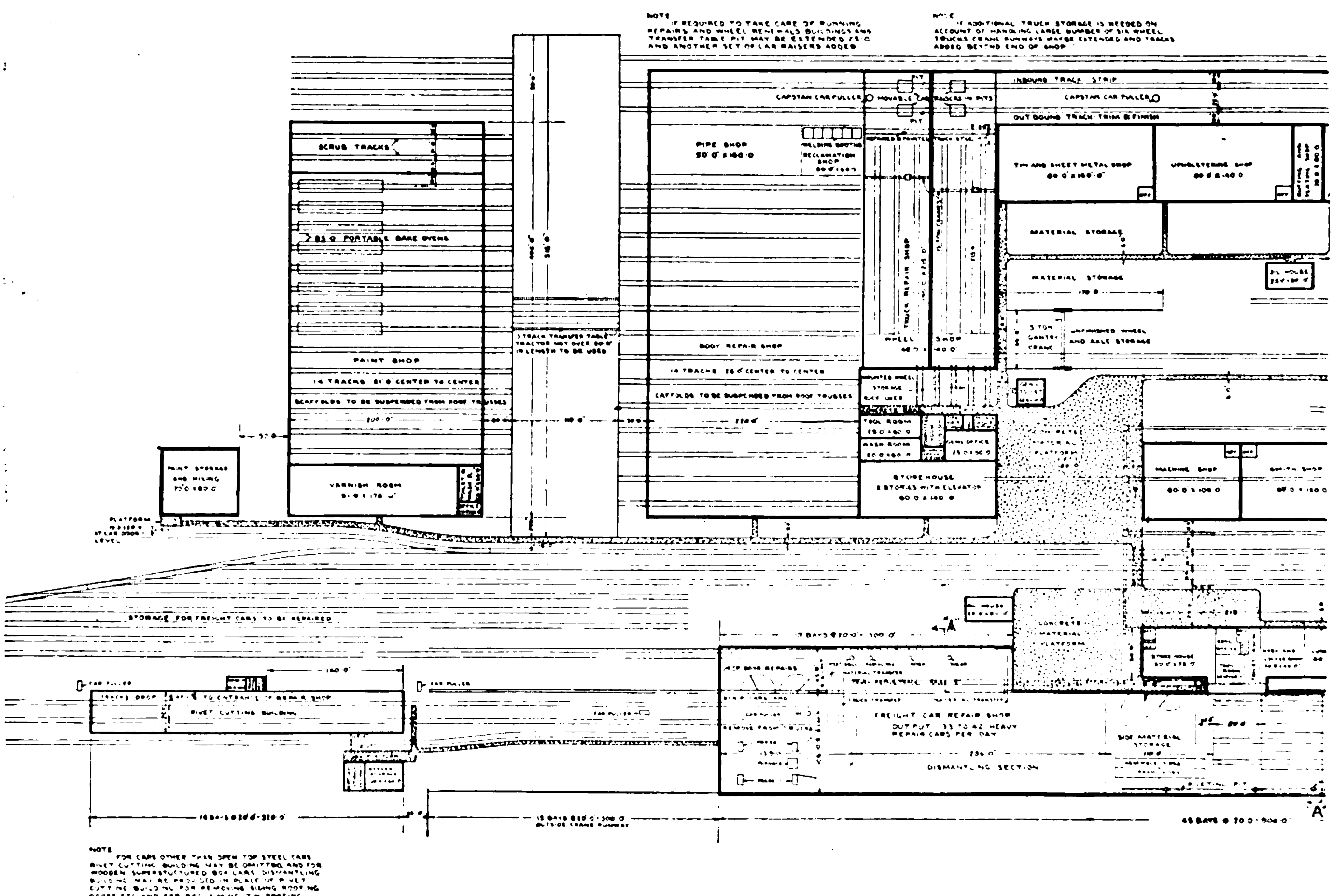
Planing mill

The planing mill is most conveniently situated outside of the main repair shop and in a separate building. The arrangement of machinery and the getting of material to and from the mill is most convenient when so situated, and also the fire hazard about the planing mill is greater than any other part of the repair shop except the paint storage room.

The lumber yard will naturally be located adjacent to the planing mill and the dry kiln interposed between the lumber yard and the planing mill. The lumber moves through the dry kiln, and from machine to machine in the planing mill with the least back motion, and thence to the shop or finished material storage. The planing mill should be steam heated, and have a concrete floor.

Cabinet shop and pattern shop

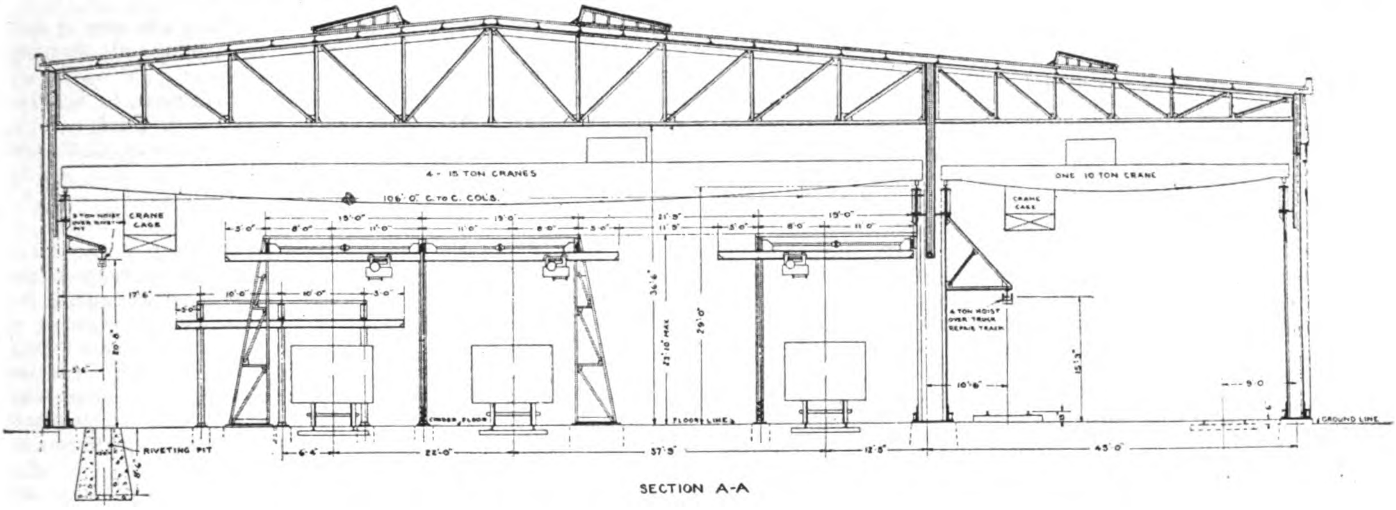
In many existing coach shops the cabinet shop is usually located on the second floor over the planing mill. There seems to be no particular reason for so locating this shop in a modern shop layout. If patterns in any quantity are to be stored a separate fireproof storage vault is advisable.



Plan No. 2—A typical passenger and freight car repair shop

The paint shop, like the repair shop, is preferably of the transverse track type having one or two cars on each track. The width of the building need be governed only by the aisle widths and the length of the cars on their trucks, as it is seldom that a car is off its trucks in a paint shop. Therefore, the building may be from 110 ft. to 125 ft. wide for a one car track shop, and from crete floor to catch the washings from cars. Wood block or other surfacing over the concrete is not required.

Particular attention must be given to the heating of the shop as its efficiency will depend upon the regularity and dependability of the heat. Where paint or varnish is applied with an air spray suitable ventilation should be provided. The shop should be piped



Drawing showing a section through the freight car repair shop—Plan No. 2

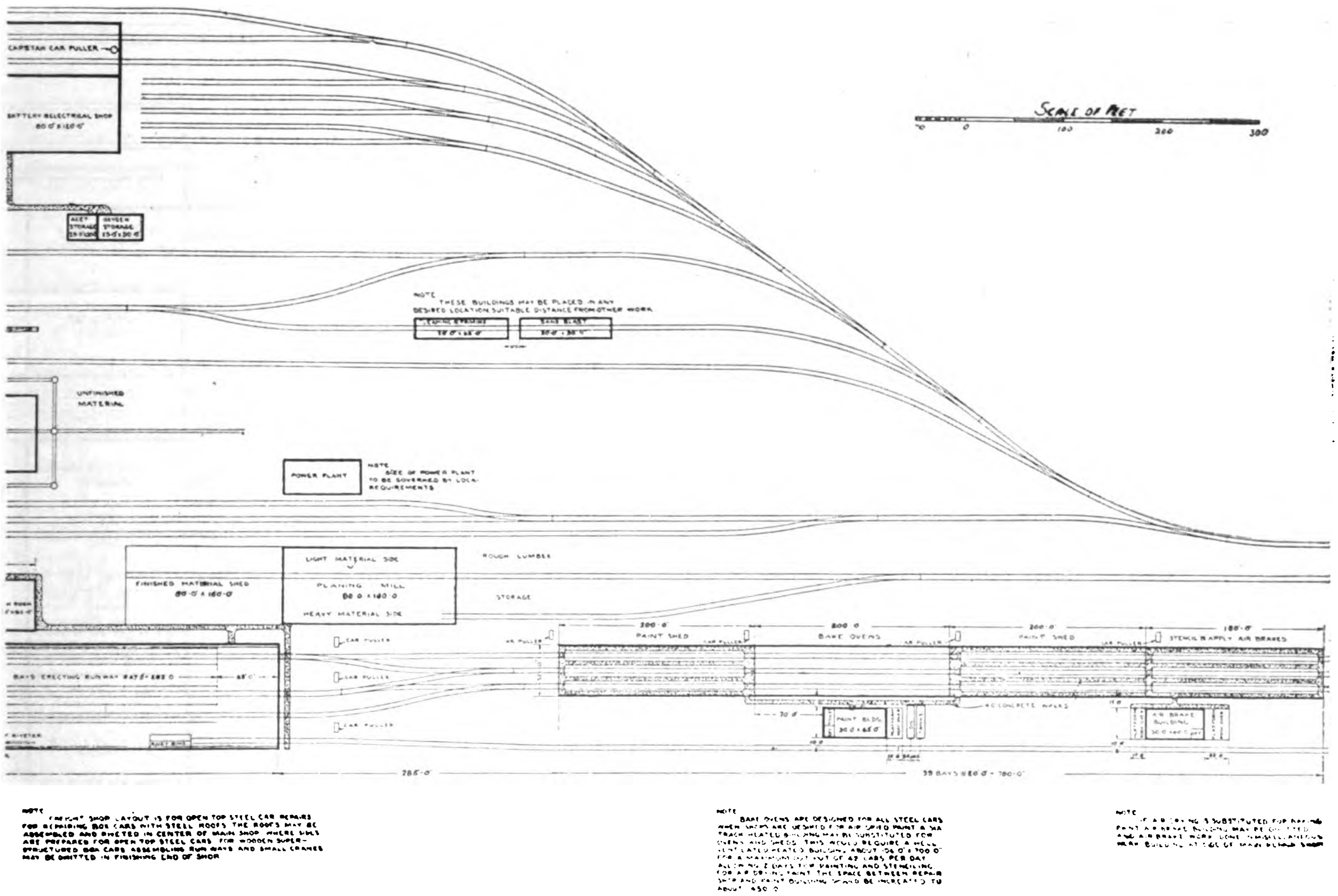
210 ft. to 230 ft. for a two car track shop which allows sufficient aisle space for materials and the workmen.

The tracks should be spaced at least 20 ft. center to center. The number of tracks required for a given output will depend upon the system of painting used. Where the bake oven process is used the painting time is about half that of where air drying is resorted to. The floors should be of concrete and amply provided with drains. In the scrub room troughs should be set in the con-

for water, air, and also gas if the latter is used for burning off paint. Scaffolding suspended from the roof trusses is necessary and the adjustable type is preferable.

Sand blast apparatus

Where paint is removed by the sand blast process the sand blast plant should be located at a distance of at least 250 ft. from the paint shop as the fine dust is easily carried by the wind. It is



—The truck shop is arranged to store the trucks inside the shop building

advisable, and in fact, almost necessary to locate a paint priming room adjacent to the sand blast building as the freshly sand blasted steel rusts almost immediately in damp weather. The priming room should be separated from the sand blast room by two partitions and a space in which air can circulate.

Platforms and roadways

Within recent years material platforms of timbers or old car sills have been superseded by concrete platforms, and such concrete platforms are to be recommended. They do not require renewing as do wooden platforms and also are more easily kept clean and material stocks maintained in order.

With modern shops much of the material is handled by power driven trucks with trailers such as electric storage battery trucks, gasoline tractor trucks, and the like. To operate such trucks efficiently requires concrete roadways and good floors in the shops. Concrete roadways and power driven trucks have practically superseded the former method of handling material by push cars and hand trucks. The concrete roads also serve as fire roads. Therefore, the location of the concrete roadways with reference to the several shop buildings and material platforms is of prime importance.

Fire protection

All railway shop plants comprise a hazardous fire risk and this is especially true of the car department particularly when wooden cars are being repaired. Therefore, ample protection against fire is essential. This protection should include:

1. An adequate source of water that can be supplied at fire pressure.
2. Water mains of sufficient size and properly located with respect to the buildings and furnishing convenient hydrants.
3. Trained fire department of the shop employees supplemented by protection from the city fire department.
4. Concrete fire roads kept clear of obstructions and having easy entrance for city fire department.
5. Sufficient hose reels in buildings, water barrels in lumber yards, and chemical fire extinguishers in paint shop or about especially inflammable materials.
6. Automatic sprinkler systems particularly in planing mill and paint shop.
7. Valves on pipe lines outside of buildings so that gas, water, air, and steam can be shut off from the buildings in case of fire, also switches on outside of buildings for cutting off electrical power and light lines that serve the buildings.

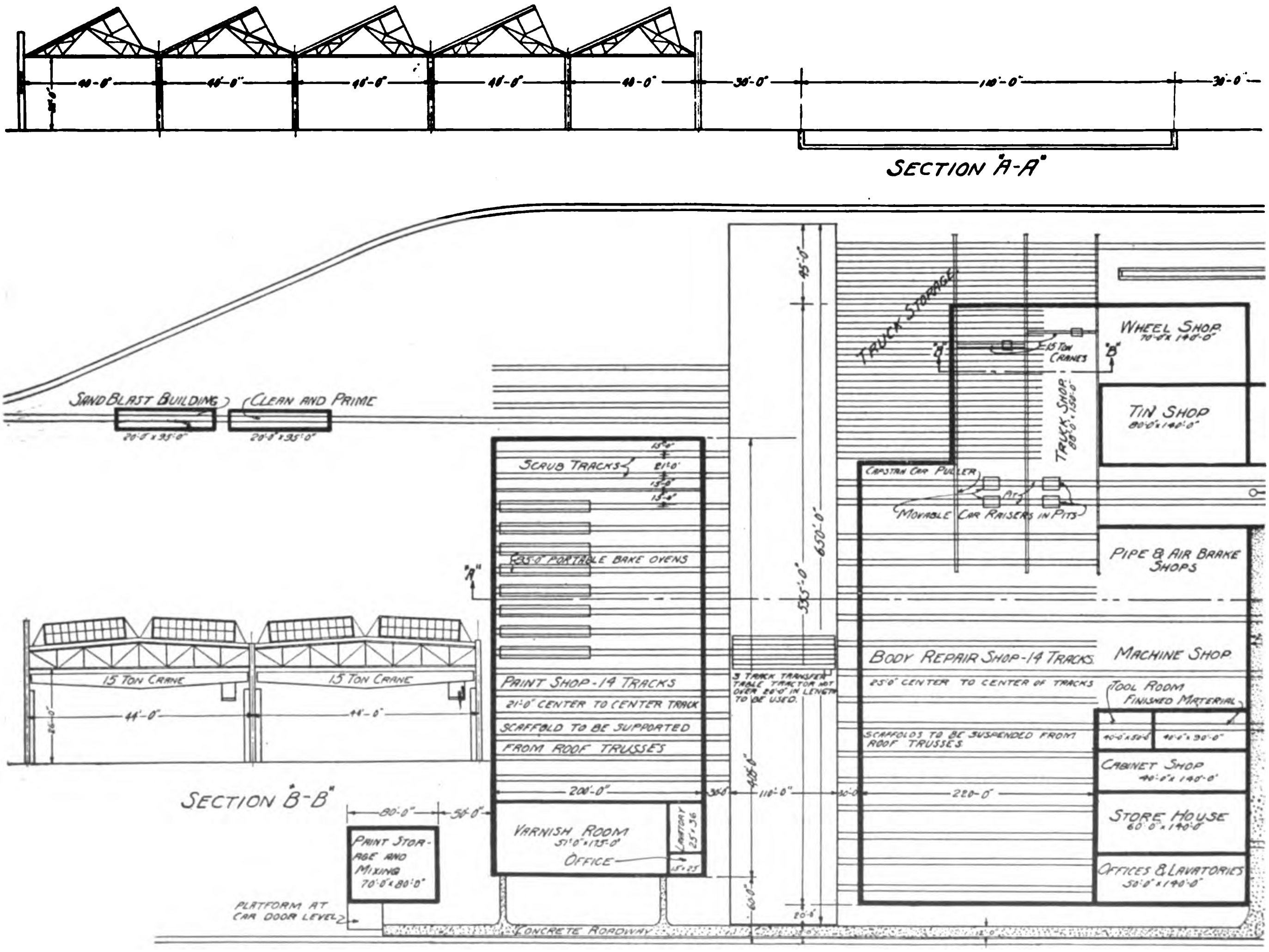
The report is signed by W. A. Callison (chairman), C. I. & L.; A. C. Davis, Penna.; I. S. Downing, C. C. C. & St. L.; B. P. Phelps, A. T. & S. F.; H. Gardner, B. & O.; J. Burns, C. P., and G. S. Edmunds, D. & H.

Discussion of plans

The layout shown in plan No. 1 is adapted only to a very large railroad. It follows the general system of repairs both in the passenger and freight car departments. The plan necessitates the moving of trucks on the transfer table which is not required in plans No. 2 and No. 3. This plan also separates the wheel shop, machine shop and blacksmith shop by some distance from the coach shop. The yard crane, however, connects these shops with the freight car shops. The tin shop is located in the coach repair shop instead of near the upholstering and electric departments as shown in plans Nos. 2, 3 and 4.

In plan No. 2, the machine shop and blacksmith shop are separated from the repair shop building but are connected to it, while the pipe shop is in the repair shop proper. The truck shop is so arranged that practically all the trucks are stored inside the shop buildings.

The truck shop in plan No. 3 is located so that a large portion of the trucks can be stored outside. Also the wheel shop has a



Plan No. 3—A proposed typical passenger car repair shop—

large outside storage platform. Unfortunately, the machine shop and wheel shops are separated by the tin and pipe shops. However, with this location of the pipe and machine shops, easier access to the storage platform from these shops is obtained. The cabinet shop in this plan is located inside of the shop building.

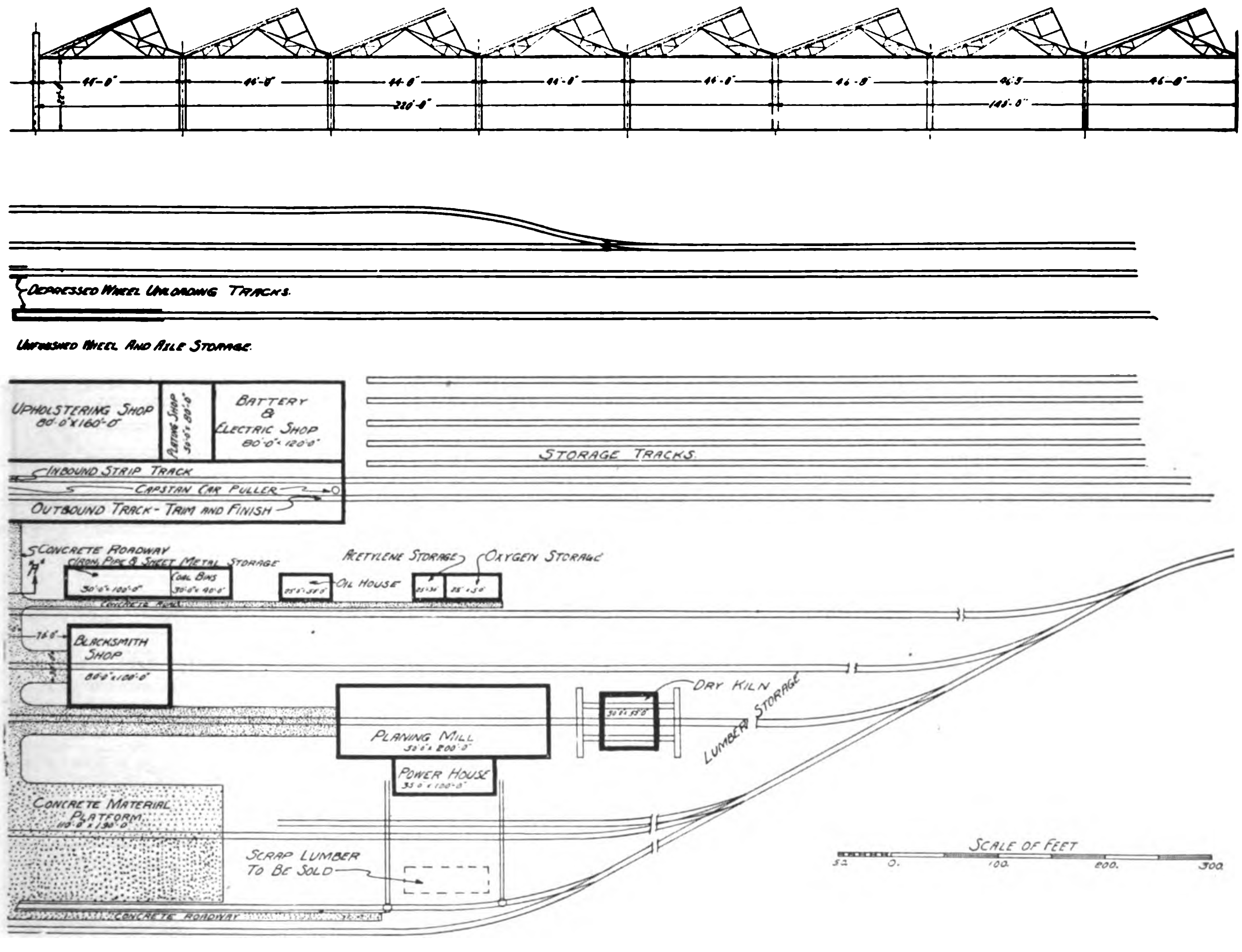
Plan No. 4 is for a smaller plant and locates all of the auxiliary facilities near the inbound and outbound tracks, including the cabinet shop next to the upholstering and varnish rooms. This plan also places the other auxiliary shops such as the pipe shop, blacksmith shop and machine shop, back of the erecting bay of the repair shop. All of these shops have access to the outside material platforms. In this plan the truck shop is supplied with a crane which operates not only over the truck shop, but over the wheel shop as well. The location of the varnish and paint storage of this plan differs from the others submitted.

Discussion

During the discussion the point was brought out that as there was very little wood in a modern passenger car, new passenger car shops should be designed primarily to handle cars of steel construction. With cars of steel body and underframe construction, all metal truck frames and rolled or forged steel wheels, the necessity of locating car repair shops in conjunction with freight car repair shops, in order to use the facilities common to both departments, is not essential. That many mechanical department officers could very well devote more attention to the study of scheduling and routing of work in the shops together with the systematic delivery and handling of material was also brought out. It was generally conceded that the plan of having both the inbound and outbound tracks adjacent, with miscellaneous shops for handling fittings and car equipment in close proximity, is the most practical and economical arrangement. One of the speakers stated that practically all of the railroads in the country would eventually have to provide facilities and equipment for repairing cars of either the gas-engine or gas-electric type and in some cases, even the full motor propelled type. While no radical changes in the plans shown in the report would be required, suitable shop space must be required for repairs to trucks, gas engine, generators and motors with which motor cars are equipped.

The problem of adapting an ideal shop layout such as proposed in the committee's report to all locations, received considerable comment. Conditions vary so much in the several districts of even one railroad that it is impractical to lay down a standard shop plan for all railroads. There are, however, certain fundamentals common to any district that should guide the designer of a shop, among which are a minimum cost of permanent installations; maximum efficiency with minimum idle time of tools and labor, and adequate provisions for safety and sanitation. Any proposed shop plan must justify its cost in actual reduction of repair expense-time to a minimum. A mere convenience is not satisfactory. One of the speakers remarked that it had been found on the road which he represented that the stripping and trimming could be performed in the building and on the tracks assigned to washing and painting, respectively. Two movements of the car were thus eliminated in shopping and the need for a special building is avoided. The trimmings, when stripped, can be loaded on special trucks and hauled in trains to the shop where they are handled. They can be collected in a reverse manner and delivered to the car whenever required.

The method of handling truck repairs received considerable discussion. It seemed to be the general sentiment that the best method of handling truck repairs was to remove the trucks from under the car and place the car body on horses and then move the trucks to the truck shop. It was considered that this procedure permitted a greater working space under the car body and kept the trucks out of the way until they were needed. However,



The cabinet shop is located inside the shop building

a number of the members spoke in favor of keeping the trucks under the cars until they were ready to be repaired.

A motion to accept the report and to continue the committee for the purpose of developing recommendations for freight car shop layout was carried.

The conservation of fuel

By F. H. Hammill

Executive vice-president, C. R. I. & P.

The following is an abstract of an address by F. H. Hammill, executive vice-president, C. R. I. & P. on the subject of fuel conservation.

The public is getting pretty critical about how we operate railroads. I have heard President Aishton of this Association say that we are going to be called upon to show whether or not we operate the railroads efficiently. And one of the big problems is what you are doing in locomotive performance; are you doing it cheaply or not.

I drew up some figures that I think are rather gratifying. It shows some things that have been accomplished. I find that on the Class 1 railroads in freight and passenger service in 1924 as compared with 1920 there was an increase of 4.4 per cent in gross ton miles, or an increase of 40 billion ton miles.

In doing that there was a decrease of 9,000,000 net tons of coal consumed, or 10 per cent. There was a decrease of $132,000,000, or 35 per cent. There was a decrease from 197 lb. of coal per 1,000 gross ton miles in 1920 to 149 lb. in 1924, or a decrease of 24.4 per cent.

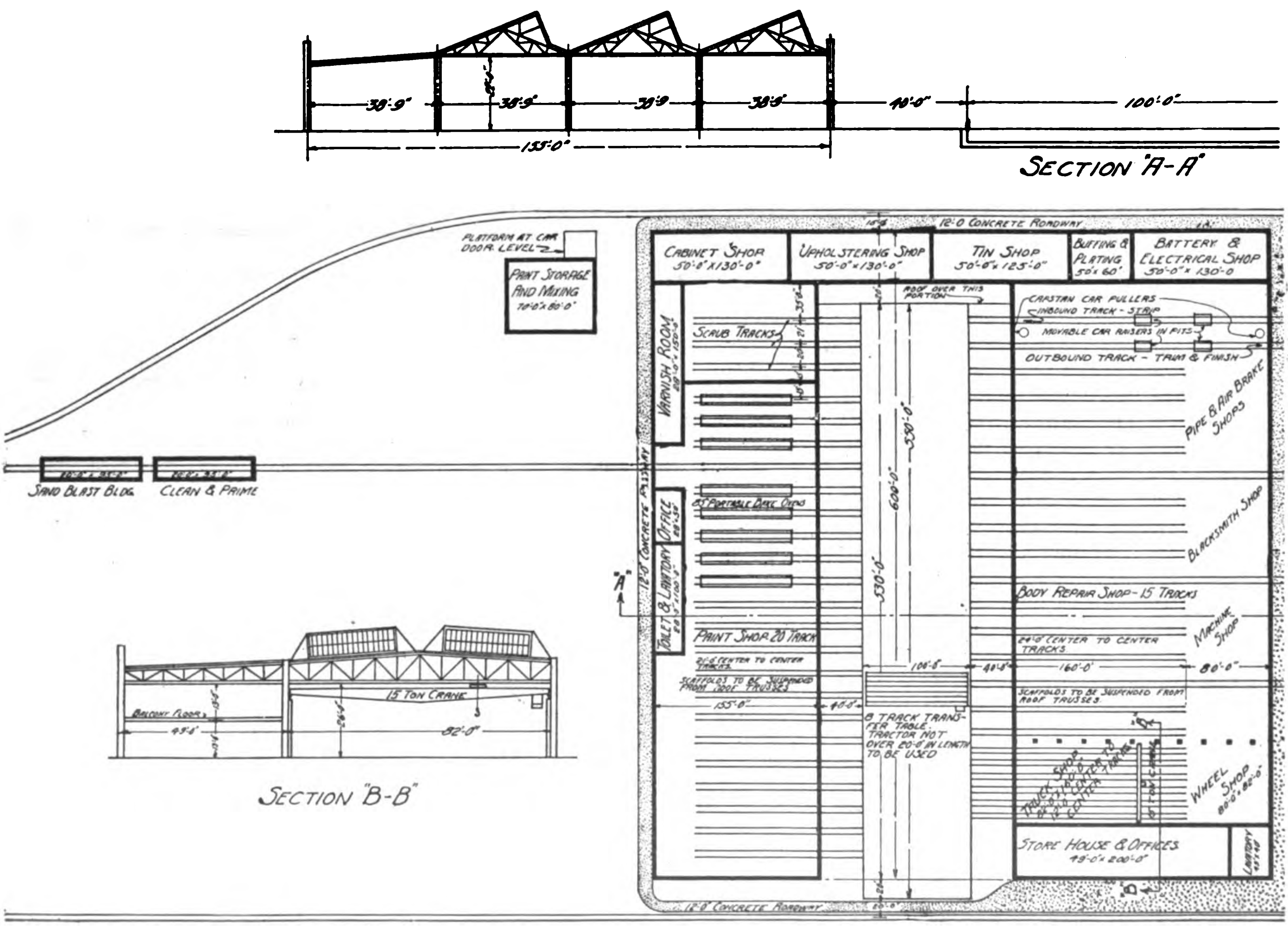
In passenger service there was an increase of 1.4 per cent in passenger car miles with a decrease of coal consumed of 8.6 per cent; a decrease of 9.6 per cent in pounds of coal per passenger car mile.

Taking the two services together we find that in the five-year period there was a total decrease of 9.6 per cent in amount of coal consumed, or 11,900,000 tons. There was a decrease in cost of coal of $180,000,000 or 34.8 per cent. That speaks fine for the mechanical men. The operating man is responsible for the coal. I know at one time it was quite the vogue to make the mechanical man absolutely responsible for the consumption of coal. I take a different position from that. I think the operating man should go with the mechanical man to the limit on the responsibility for that performance.

In the work of the joint committee of the American Railway Association and the International Railway Fuel Association on coal conservation we have been giving quite a little study recently to whether we had gone as far as we ought to as a joint proposition. We are going to win or lose as a transportation machine, not as individual railroads, but on whether we delivered the goods as transportation men. We all know what we have done so far as individual railroads in looking after this coal conservation. The question in the minds of the committee is, shouldn't we do something as a joint proposition. One of the things that I want to call your attention to is this: There were some very fine papers prepared on the question of fuel economy in book form. We find through the committee on coal conservation that they were not distributed as much as we on the committee feel would be of value to the railroads. I would like to call your attention to that so you may look into it.

The next thing is, should we adopt some method of unified testing. We make tests on our various railroads. There is a question in the minds of the committee if it is not necessary for us to go beyond that, not only to defend ourselves in connection with rates and in connection with our transportation as a whole but also to help us to bring about the results we ourselves consider necessary.

Our committee has made a recommendation to the A. R. A. as to whether we should not avail ourselves of some of these



Plan No. 4—A proposed typical passenger

colleges that have good testing plants so we can get some universal information. We all know what the superheat has done for the locomotive. We have other appliances that we know about. If we had some plan of that kind, couldn't we get more detailed information?

We ought to get our problems before the people just the same as other groups get their problems before them. If I have any criticism to offer at all about the transportation business it is that we have been a little too prone to lay back and not talk our subject. The time has come when we should talk.

At the Illinois State University, at Purdue and I think also at Iowa State College are good testing plants. If we could get together as an Association and work out some plan of utilizing these plants we would not only develop the information for the railroads as a whole but we would come in contact with the boy getting his education. He goes back home and gets into some little argument there about the railroads, how they are conducted and whether they are properly conducted. The boy says, "I think they are because right at the present time at the Illinois University where I am going we have locomotives there testing them out. Why? So as to reduce coal costs and enable the railroads to operate as cheaply as they can."

Report on locomotive utilization

The Joint Committee on Utilization of Locomotives presents herewith a report of progress. The committee has collected and analyzed considerable data on this subject, and has conducted some field surveys of operating conditions and performance. From this study, it is evident that the railroads generally are fully alive to the importance of this subject, and very creditable performance is being made.

The performance indicated by these surveys and studies of the Committee is as a result of the careful application of the following principles:

1—Locomotives are given such maintenance attention at monthly periods, preferably at certificate time, to condition the locomotive to run to the next monthly repair time with the minimum of light running repairs. This plan reduces materially the average mechanical time held at terminals, is a great factor in reducing engine failures, and provides a definite plan of running maintenance for keeping the locomotive in better condition.

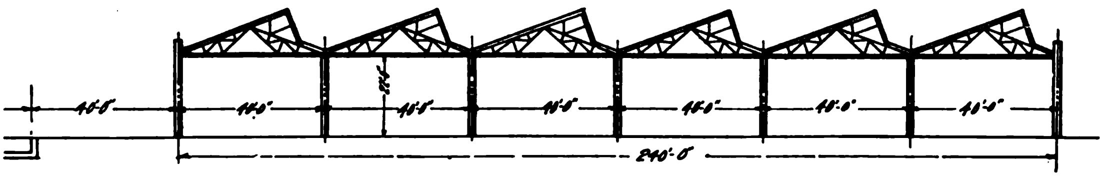
2—Detailed analysis of operating conditions on each division is made to determine the practicability and economy of increasing the miles per locomotive despatchment. The ability and capacity of modern locomoitves to make long sustained runs successfully has been definitely established.

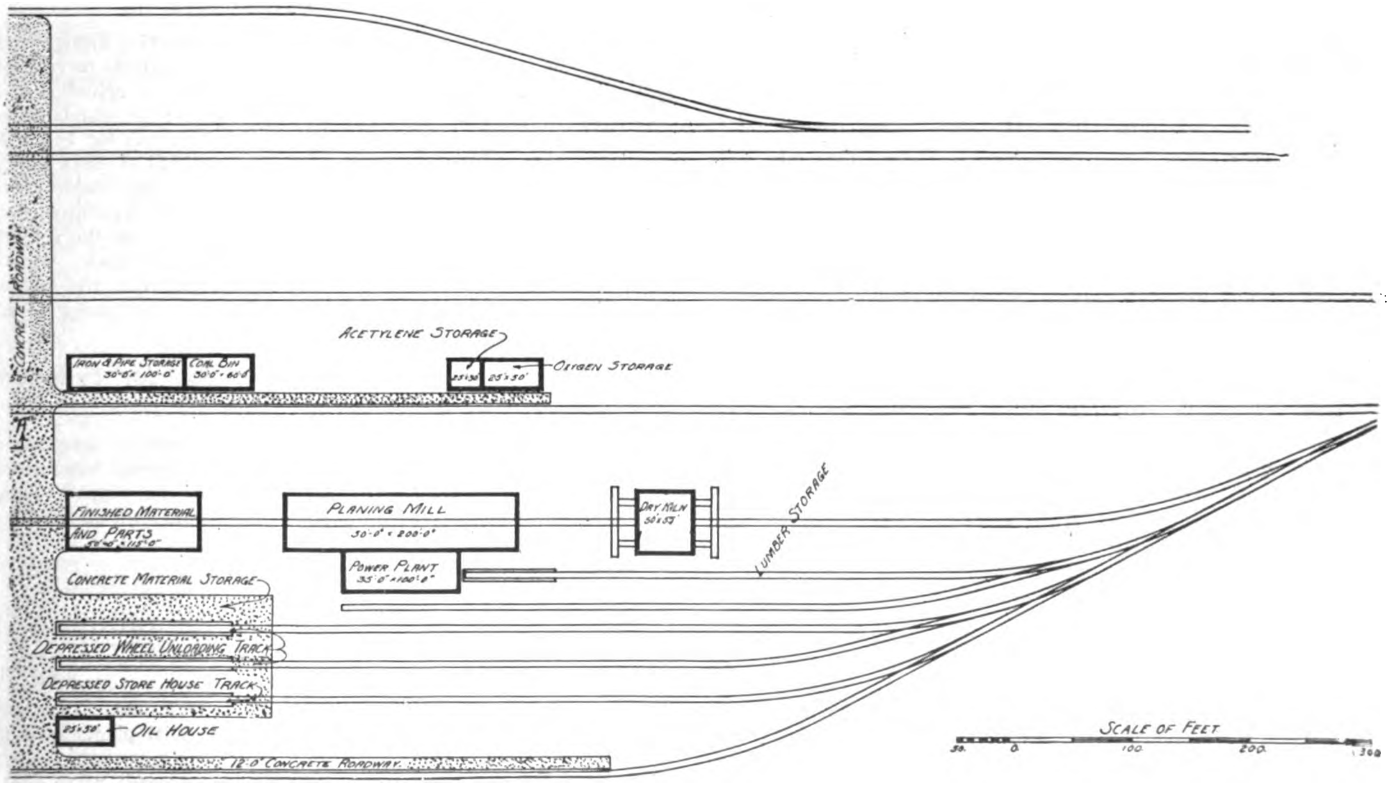
3—Methods pursued in placing locomotives in and withdrawing locomotives from reserve, are very carefully worked out and adhered to. Consideration is given to placing this on miles per day basis, and placing the responsibility therefor on the division people. Specified miles per day are established for all classes of service for each division. Authority and responsibility is definitely placed on the division trainmaster and master mechanic for the number of locomotives in service to maintain this mileage.

4—Time for initial and final terminal delay at each point is established. Consideration is given to the location of route between engine house and yard, and interference encountered in this movement. Consideration is also given to relatively low cost capital investment improvements that will expedite this movement. Definite responsibility is also placed for the maintenance or improvement of this established figure with a local transportation officer.

5—The maintenance of specific locomotives is assigned to specific engine houses, and the utilization of inadequately equipped terminal facilities for turn-around purposes only.

6—Methods followed at yard offices in computing train loading and supervision held responsible therefor is also carefully in-





car shop—This plan is for a small plant

vestigated and studied. This matter is also followed up by the operating officers.

7—Consideration is also being given to re-location of or additional fuel and water facilities with reference to stops fouling the yard or cross-over switches, the location of these facilities with reference to the main tracks and the development of plans predicated on extended runs for correct location of facilities.

8—Statistics relating to performance of locomotives are carefully maintained and studied as relating to average miles per locomotive per month, gross ton miles per train mile, gross ton miles per train hour and related transportation statistics.

9—Thorough consideration is given to the reduction of freight train road delays with reference to despatching, spacing, overtime, relatively low capital investment improvements, and the method of supervising outlying points where congestion often exists and points where fuel and water are obtained.

10—Prior classification is obtained as far as possible and restriction of pick-ups and set-offs reduced to a minimum number of trains.

Where the greatest utilization of locomotives is obtained, and the best performance found, the above principles are being applied by operating officers on each division. Also, the operating and mechanical officers of the entire railroad are displaying the greatest interest in the subject. The committee invites suggestions and information as to the other practices which have been found effective by the members.

Upon request, executive officers of railroads will be supplied with confidential copy of reports of field surveys made by the committee.

[Attached to the report were tabulations of condensed operating statistics of a selected number of roads and of all Class I roads.—Editor.]

The report is signed by the following:

Representing Operating Division: T. B. Hamilton, vice-president, Pennsylvania; J. T. Gillick, general manager, Chicago, Milwaukee & St. Paul, and A. E. Ruffer, transportation manager, Erie.

Representing Mechanical Division: W. H. Flynn, superintendent motive power, New York Central; W. H. Fetner, chief mechanical officer, Missouri Pacific, and O. S. Jackson, superintendent motive power and machinery, Union Pacific.

Discussion

O. S. Jackson (V. P.) briefly described the system of making running repairs periodically on the Union Pacific. Locomotives, he said, are now in better condition, as reflected by a notable reduction in the number of engine failures. The figures per 100,000 locomotive-miles being as follows:

Year 1920	3.57 failures
Year 1921	2.10 failures
Year 1922	3.29 failures
Year 1923	1.54 failures
Year 1924	1.11 failures

Since the adoption of this plan maintenance costs have also been reduced. While it was not considered that the plan itself was entirely responsible, it was felt that it had an influence on the reduction of costs of running repairs. It was also a factor in increasing the mileage between general overhaulings. The plan used is as follows: When a locomotive is due for the regular monthly inspection required by Federal law, it is held long enough to be given such attention as is necessary to put in condition to perform satisfactory service until the next monthly Federal inspection is due. This work is handled along definite lines and under certain prescribed rules for each locomotive held, depending on its condition, length of time out of shop, class of service, etc. With the ordinary trip inspections and ordinary light running repairs during the intervening time, locomotives can be, and are, put in condition to operate successfully between monthly inspections.

The Union Pacific, Mr. Jackson said, has been able to reduce its active locomotive assignment by about 25 per cent as a result of increasing the miles per locomotive despatched, and as a result of this experience has extended this method of operation until all main line power, both freight and passenger, are assigned to long runs. The only exceptions are the local and branch trains. Passenger locomotives are now assigned to runs of from 483 miles to 640 miles in length and freight locomotives from 225 miles to 337 miles in length. From an economical standpoint this method of operation has met the fullest expectations, he said; the saving in locomotive investment and in intermediate terminal improvements and maintenance and the reduction in the amount of fuel used at intermediate terminals, represents a large saving in operating costs. In addition to the saving in fuel used on the locomotives at intermediate terminals, there has also been a considerable reduction in the amount of coal used in the power plants of these terminals. As an instance he cited the saving of 540 tons per month at the Rawlins, Wyo., power plant, by running freight locomotives through from Green River, Wyo., to Laramie, with practically no increase in the amount used at these two terminals.

J. M. Nicholson (A. T. & S. F.) stated that the investigations of the committee show a mileage of from 11,000 to 12,000 per month for passenger locomotives and of 5,000 to 6,000 per month for freight locomotives on portions of certain railroads, and that such mileages are resulting where locomotives are in productive service approximately 50 per cent of the time. He called attention to the fact that locomotives are being turned at terminals on some railroads operating long runs in 12 hours, of which approximately 8 hours is required for mechanical attention and 4 hours for transportation delay awaiting trains, and suggested that if this represents the minimum amount of time necessary, a greater locomotive utilization will result if a reduction of terminal time to this figure can be effected. He called attention to the fact that conditions existing on certain divisions lend themselves best to turn-around runs and in others to the regular assignment of locomotives to crews, while in some cases the best results may be obtained by pooling the locomotives on a single district, with turntable attention at one terminal and all maintenance taken care of at the other. He said that the best utilization, however, is being made by extending runs over more than one operating division and that this operation is recommended by the committee wherever practicable.

The importance of having favorable fuel, water and weather conditions in order to operate extended locomotive runs successfully was referred to in the discussion, as was also the fact that the arrangement or proper coaling facilities on the main line must be taken into consideration.

J. Purcell (A. T. & S. F.) said that in running locomotives on runs from 349 to 600 miles during the past year or two it had been found that in addition to the fuel saved in firing up there were less firebox, flue and staybolt failures than before the long runs were adopted.

Report on locomotive design and construction

During the past year the Committee on Locomotive Design and Construction gave consideration to the comparative merits of hydrostatic and force feed lubrication for locomotive cylinders and steam chests, and the best methods of application; the standardization of taps and dies used by railroads, and standards for bolt and screw threads; definition of an engine failure; rail stresses under locomotives; standardization of water columns; removable hand rail columns; and special designs of engines. The committee had no authority to conduct tests to obtain original data on the subject of rail stresses under locomotives and no report was made. However, investigations are in progress at the present time, the results of some of which have already been published. Following is an abstract of the reports on several of these subjects.

Hydrostatic and force-feed lubrication for cylinders and steam chests

Inquiries sent to the manufacturers of locomotive force feed lubricators requesting a statement as to the number of lubricators in service or on order as of March 1, 1925, developed that there are now in service, or on order, force feed lubricators of the various types, as follows:

Nathan Manufacturing Co.		386
United States Metallic Packing Co.	McCord	694
Formerly Locomotive Lubricator Co.	Schlacks	1308
Edna Brass Manufacturing Co.		36
Madison-Kipp Corporation (Information not available)		
		2,424

These lubricators are distributed over quite a wide range, including 76 railroads and 13 logging or commercial plants owning locomotives.

The expressions received from the various railroads using force feed lubricators indicate that this method of lubrication is exciting

considerable interest, and as a general proposition is establishing a favorable impression. A total of seven roads co-operated with the committee in the pursuit of this subject. These reports embraced the comparative performance of hydrostatic versus force feed lubrication on a total of 22 locomotives. With the exception of four, these locomotives were equipped with hydrostatic oil delivery to one side and force feed delivery to the opposite side. The summarized results referred to, and from which some conception may be obtained of the influence of the method of oil delivery upon packing ring service, rate of wear and oil consumption, are shown in the table.

In preparing the table showing the relative results obtained from the two systems of lubrication, the record as obtained in passenger and freight locomotive service has been separated according to the class of service, following which a combination of the results, including both passenger and freight service, is also shown. There were 14 passenger locomotives under observation, during which time 38 valve rings in the hydrostatically lubricated positions, and 45 in the force feed lubricated positions were removed on account of being worn, broken or down. From these valve rings an average service of 13,471 miles was obtained with hydrostatic lubrication, and 11,749 miles with force feed lubrication. From these same locomotives there was a total of 72 and 104 cylinder packing rings removed from the hydrostatic and force feed positions respectively. The average mileage per cylinder ring was 7,600 for the hydrostatic, and 6,550 for the force feed.

A representative number of rings removed were measured for radial wear at five equally spaced points around the ring from the ends, and from the mileage performance record of these rings the average rate of wear per 10,000 miles has been determined, which, for the hydrostatic lubrication, was .027 in.; force feed lubrication, .029 in., the rate of wear being practically equal. Comparing the mileage made per pint of oil there is a marked difference favorable to force feed lubrication since an average of 50.6 miles per pint of oil was secured as against 30.5 miles for the hydrostatic. Attention is called, however, to the wide range in the oil consumption figures as indicated by the maximum and minimum results. With hydrostatic lubrication the maximum and minimum mileage per pint was 49.1 to 15.9 miles respectively, while with the force feed lubricator the range was from 101.8 to 21.4 miles respectively.

In freight service, there was a total of eight locomotives under observation. The performance of the valve packing rings was not sufficiently complete to enter into the comparison. Considering the cylinder packing rings there was a total of 22 removed from the hydrostatic and 25 from the force feed positions. The average mileage made by these packing rings was 1,954 and 2,600 for the hydrostatic and force feed lubricators respectively. Comparing the performance on the basis of the average radial ring wear per 10,000 miles, the record shows a rate of .239 in. and .197 in. for hydrostatic and force feed lubrication respectively. The mileage per pint of valve oil in freight service was favorable to the hydrostatic lubrication, 32 miles having been realized as against 26.7 for force feed lubrication. It is necessary to call attention to these individual values established in the comparison of the two methods of lubrication in order that a comprehensive idea of the results of this study as a whole may be obtained.

In passenger service a difference of 13.8 per cent in cylinder packing ring service in favor of hydrostatic lubrication is shown, while in freight service a difference of 33 per cent favorable to force feed lubrication is recorded. On the basis of radial cylinder packing ring wear per 10,000 miles service, the results from the two systems of lubrication are practically equal in passenger service, while in freight service a difference of 17.6 per cent is shown favorable to force feed lubrication. Considering the mileage obtained per pint of valve oil, a difference of 65.9 per cent favorable to force feed lubrication in passenger service is shown, while in freight service the difference is 16.6 per cent, favorable to hydrostatic lubrication.

In the consideration of the performance record to which reference has just been made, no striking difference between the two systems of lubrication from any basis of comparison carries through both freight and passenger service. In passenger service a better valve and cylinder packing ring performance was obtained from hydrostatic lubrication, while a better mileage performance per pint of valve oil was secured from force feed system. In freight service a better cylinder packing ring performance was obtained from the force feed system, while a better mileage performance per pint of valve oil was obtained from the hydrostatic system. There is a slight difference favorable to force feed lubrication.

Hydrostatic versus mechanical lubrication of locomotive valves and cylinders

			Rings removed (worn, broken or down)						Cylinder packing ring wear					Causes of cylinder ring removals				Engine miles per pt. of valve oil			
			Valve			Cylinder															
Type of lubricator	No. of roads	No. of engines	Total no.	Total ring miles	Av. mls. per ring	Total no.	Total ring miles	Avg. mls. per ring	No. of rings considered	Total ring mileage	Total	Per ring	Per 10,000 miles	Broken	Down	Worn	Total	Maximum	Minimum	Average	Total Engine mileage
										Passenger											
Hydrostatic	5	14	38	511,917	13,471	72	547,182	7,600	20	488,631	1.298 in.	.065 in.	0.027 in.	32	20	20	72	49.1	15.9	30.5	
Mechanical	5	14	45	528,715	11,749	104	681,157	6,350	32	710,616	2.092 in.	.065 in.	0.029 in.	18	28	58	104	101.8	21.4	50.6	711,060
										Freight											
Hydrostatic	3	8	0	......	.....	22	43,007	1,954	11	46,944	1.123 in.	.103 in.	0.239 in.	1	2	19	22	48.5	13.6	32.0	
Mechanical	3	8	0	......	.....	25	65,004	2,600	15	68,738	1.357 in.	.090 in.	0.197 in.	1	5	19	25	42.9	12.6	26.7	121,034
										Passenger and Freight (Combined)											
Hydrostatic	7	22	38	511,917	13,471	94	590,186	6,279	31	535,575	2.421 in.	0.078 in.	0.045 in.	33	22	39	94	49.1	13.6	31.1	
Mechanical	7	22	45	528,715	11,749	129	746,161	5,784	47	779,354	3.449 in.	0.073 in.	0.044 in.	19	33	77	129	108.1	12.6	40.7	832,094

The committee, in reporting on the standardization of taps and dies and also on the accepted standards for bolt and screw threads, suggested that in view of the disposition of the railroads and the association to adopt screw threads which do not conform to the Sellers or U. S. Standard tables, particularly for special purposes, such as boiler work, pipe work, injector couplings, etc., the statement on page L-27 of the Manual, to the effect that "The Sellers or Franklin Institute system of screw threads is the standard of the Association" should be qualified so as to avoid conflict between this statement and other standards and recommended practices which have been, or may be, adopted.

The committee feels that in the case of thin castle nuts, whose use, insofar as locomotives are concerned, is confined almost exclusively to crank pins, knuckle pins, crosshead pins, piston rods, etc., the form and number of threads per inch in the nuts should be governed by the threading of the parts to which they are applied.

The committee also feels that the form of threads to be used for lubricator fittings should be definitely specified.

Attention has been called by the committee on Locomotive and Car Lighting to the fact that the association has no standards for bolts or machine screws smaller than ¼ in. diameter, which is the smallest size included in the Sellers or U. S. Standard tables. This committee has therefore undertaken the work of ascertaining the present practices of the various roads with regard to sizes and threading of machine screws.

Status of standard threads

Information has been received from 20 roads. Fifteen report having no standards of their own, but are either following, or rec-

ommend following, the A. S. M. E. standards. Three have adopted as standard a certain number of sizes which are included in the A. S. M. E. standards, but have not adopted the entire A. S. M. E. table. Two roads report having standards of their own which do not agree with the sizes and threading found in the A. S. M. E. tables. In view of the predominance of the A. S. M. E. sizes, it seems proper that the sizes and threads that are adopted for machine screws should be selected from the A. S. M. E. tables.

As the Operating Division has not yet appointed a committee to confer with this committee on engine failures a report of progress only is made. The following memorandum is submitted for discussion and with a view of obtaining the views of the members for the benefit of the committee for future consideration.

1—All delays waiting at initial terminal caused by some defective part of locomotive.

2—All delays on account of the locomotive breaking down, running hot, not steaming well, or having to reduce tonnage, on

(g) Locomotive steaming poorly or flues leaking on any run where a locomotive has been delayed (for other cause than defects of locomotive) on side tracks or on the road an unreasonable length of time, say fifteen hours or more, per 100 miles.

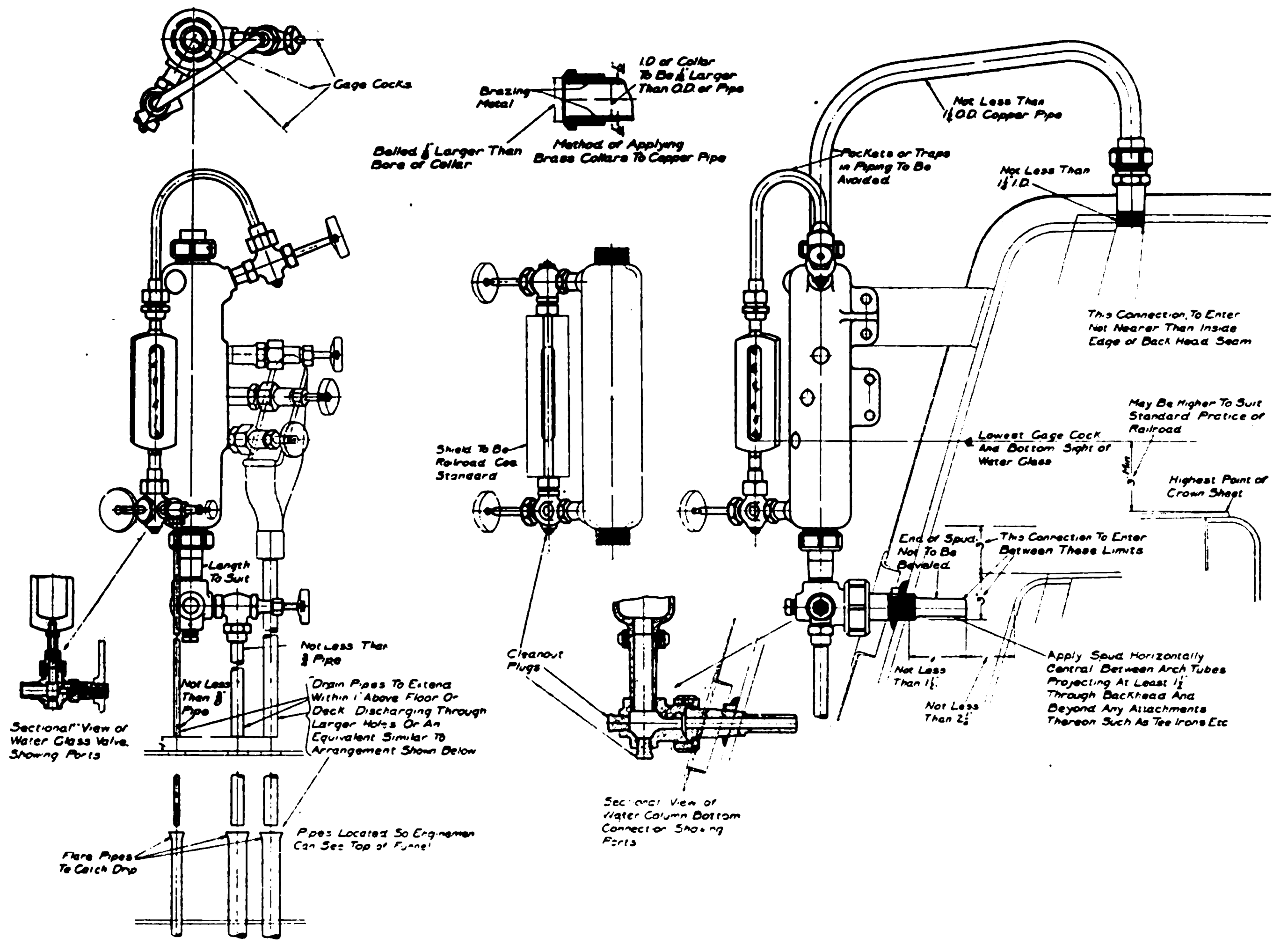
(h) Reasonable delay in cleaning fires and ash pans on the road.

(i) Failure of locomotives coming from outside points to shops for repairs, whether running light or hauling a train.

(j) Delays due to insufficient time having been allowed in which to make needed repairs or to get the locomotive ready for the time the train is ordered to leave, when the operating department was so advised at the time locomotive was ordered.

(k) Broken draft rigging on locomotives and tenders, caused by a bursting hose of the train breaking-in-two.

(l) Delays to fast scheduled trains when weather conditions are such that it is impossible to make time; providing the locomotive is working and steaming well.



Drawing showing the application of the water column to the back head

account of defective locomotive, making a delay at terminal, meeting point, junction connection or delaying other traffic.

The following will not be considered as locomotive failures:

(a) When locomotives lose time and afterwards regain it without delay to connections or other traffic.

(b) When a passenger or scheduled freight train is delayed from other causes, and a defective locomotive makes up more time than it loses on its own account.

(c) Delays to passenger trains when such delays are less than five minutes at terminals or junction points.

(d) Delays to scheduled freight trains when they are less than twenty minutes late at terminals or junction points.

(e) Delay when a locomotive is given tonnage in excess of rating and stalls on a grade, providing the locomotive is working and steaming well.

(f) Delays on extra freight trains if the run is made in less hours than the number of miles divided by ten.

(m) Delay due to the locomotive being out of fuel or water, caused by being held between fuel or water stations an unreasonable length of time.

Report on standardization of water columns

In the report on the standardization of water columns the committee made a total of 28 recommendations for future installations which are as follows:

1. All water columns and water glasses must stand vertically.

2. The water column should not be less than three inches inside diameter and of sufficient length to accommodate the length of water glass required for the operating conditions and to have a clear opening for the top connection of not less than 1½ in. inside diameter and be connected to the boiler with not less than 1½ in. outside diameter copper pipe, tapped into the boiler on the top center or in a location not farther to the side than nine inches and

not nearer than nine inches to the inside edge of the back head seam.

3. The top spud connection standard in the boiler to be not less than 1¼ in. inside diameter.

4. The bottom end of the column, to provide for vertical range in location, should be supported and connected to the boiler with a heavy cross connection and spud with clear straightway bored port ¾ in. diameter, with the cleaning plugs located opposite the horizontal and vertical ports. The spud should be of forged steel or bronze of ample strength to carry the weight of the column and attachments.

5. The bottom water column vertical connection to be not less than 1¼ in. inside diameter, preferably larger.

6. The back head of the sloping type may be reinforced with open hearth steel bevel washers, welded in place to provide horizontal application to the bottom spud.

7. The bottom spud must not be located in a radius or knuckle of the back head flange or immediately above the arch tube opening.

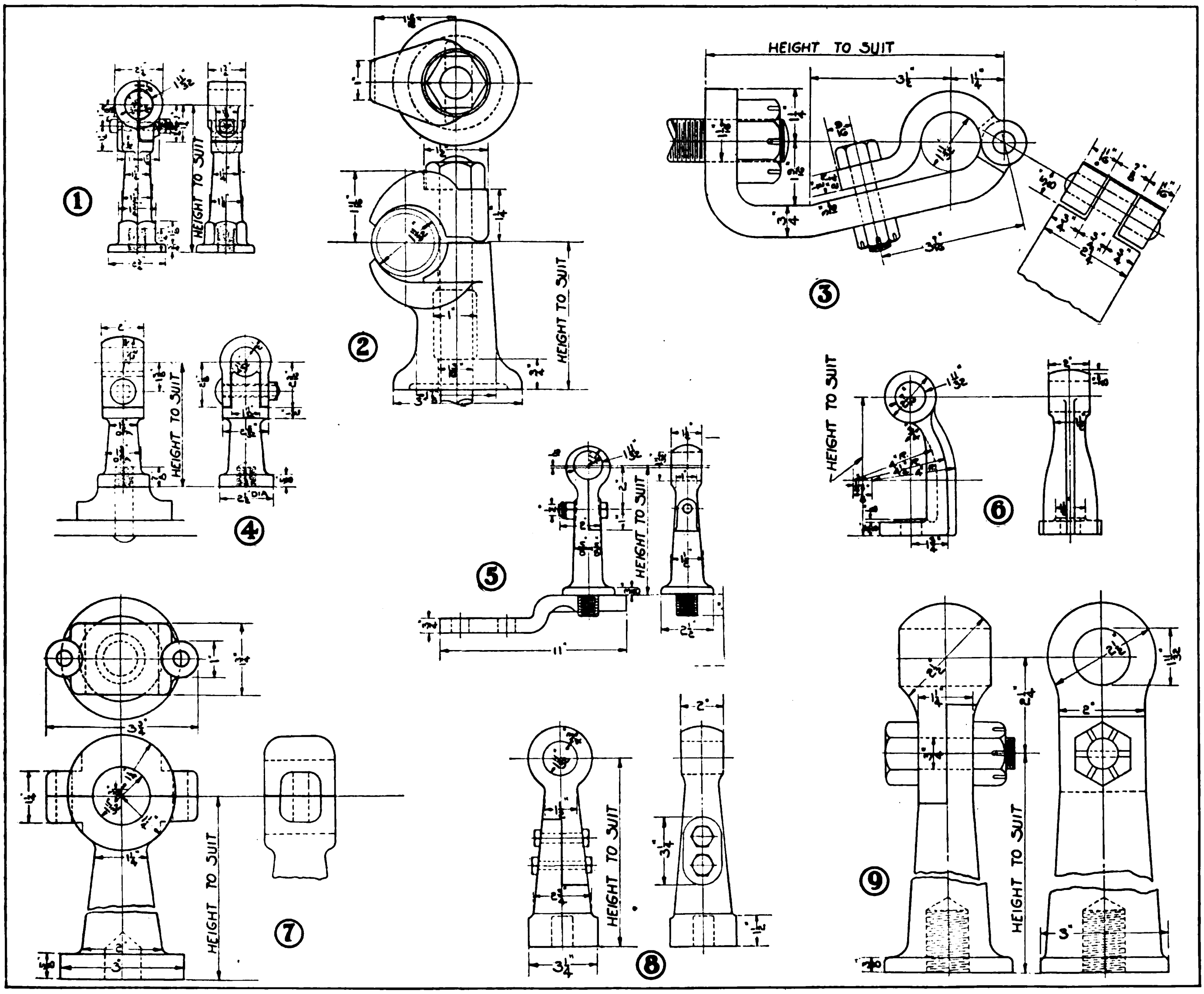
8. The inner end of the bottom spud must extend not less than 1½ inches through the back head and beyond any attachments thereon, such as the tee, angle iron, boiler braces, etc., to avoid location within a water eddy or pocket where water may dam up.

9. The inner end of the spud must not extend to or be less than 2¼ inches from the firebox door sheet and be located in a vertical range between 3 inches below and 3 inches above the back end of the firebox crown sheet.

10. The water column, vertical location, must be at such a height that the lowest gage cock attached therein, and the lowest visible reading of the water gage shall be not less than 3 inches above the highest part of the crown sheet and may be located higher, to suit the standard practice of any railroad.

11. The bottom connection of the water column must be equipped with not less than ¾ in. drain pipe and valve, preferably one-inch, which can be easily opened and closed by hand, so that the water column and connection may be frequently blown out. The drain pipes should be well braced and extend separately to within one inch of the cab floor or deck, and discharge the waste steam or water through a hole, slightly larger than the diameter of the pipe, or an equivalent arrangement whereby the leakage discharged through these pipes may be observed above the deck.

12. Water columns should be located well toward the center of the back head of the boiler to afford protection and to avoid violent fluctuation of the water while rounding curves. Extension handles to be applied to gage cocks when necessary, so as to bring them within easy reach of the engineman.



The nine designs of hand rail columns submitted by the Committee on Locomotive Design and Construction

13. Gage cocks must be not less than ¼ in. inside diameter.

14. The top end of the water column should be securely braced to the back head with a brace sufficiently heavy to carry the weight of the column and overcome vibration.

15. The water column should be equipped with one water glass and three gage cocks.

16. The lowest reading of the water glass to be on line with the center of lowest gage cock.

17. The water glass of the Klinger or other Reflex type should

have stems not less than ⅝ in. outside diameter and ⅜ in. inside diameter.

18. Tubular glass when used to be ⅝ in. outside diameter.

19. The top and bottom pipe connection to the water column and water glass must be applied without gaskets.

20. The water glass steam pipe connection not less than ½ in. outside diameter, preferably ⅝ in. outside diameter.

21. The water glass, Klinger or Reflex type, top and bottom valve connection bore ⅜ in. diameter, "and bottom connection provided with cleaning plug located opposite the vertical port and the side outlet for the blow off pipe connection."

22. The water glass, tubular type, top and bottom valve connection bore not less than ¼ in., preferably 5/16 in., "and bottom connection provided with cleaning plug located opposite the vertical port and the side outlet for the blow off pipe connection."

23. The water glass vision not less than six inches, preferably eight inches, depending on operating conditions.

24. The tubular type water glass when used must be equipped with a removable safety shield which will prevent glass from flying in case of breakage.

25. The water glass must be so located and maintained as to be quickly observable by the enginemen.

26. The water glass must be equipped with a bottom blowout valve and pipe not less than ⅜ in. diameter.

27. Steam pipes to be applied without sharp bends or pockets and provided with ball joint connections and belled at least ⅛ in. in diameter at the end in the bracing collar.

28. Application is shown by drawing.

Removable hand rail columns

The committee submitted nine different designs of hand rail columns which provided for the ready removal of the hand rail. Local conditions, the position of the hand rails and the uncertainty as to a general demand for such a design suggested the presentation of several designs which embodied this special feature. The report recommended that individual railroads considering the use of a removable hand rail should be in position to select from the several designs submitted, one that would probably meet their requirements.

Locomotive development

There has been a remarkable reawakening of interest in increasing the efficiency of the modern locomotive, with two main objects in view; first, fuel economy, and second, increased utility of the machine.

While this movement is attributed by some to the demands of the general public, it is the committee's opinion that it has been brought about by the necessity of improving the locomotive to meet changing conditions of traffic and to keep pace with the great improvements in roadway, terminals and general industrial developments. Coincident with this, great interest has been aroused in fuel saving devices due to the increase in fuel costs, forcing engineers, particularly in foreign countries, to investigate the possibilities of the turbine and internal combustion locomotive. These developments and the building of heavy electrical locomotives have served as a means of advertising the shortcomings of the steam locomotive, unjustly, thereby preventing to a great extent, a realization of what is being done to increase the efficiency of the orthodox types of steam locomotives.

The body of the report contains a summary of the progress being made in steam locomotive development along conservative lines; it listed the major improvements to ordinary designs of locomotives, cited examples by which increased boiler capacity had been obtained, gave an account of the advantages obtained by the use of positive limited cut-off and the development of the three-cylinder locomotive. The report also reviewed the economies effected by changes in operating practices and their effect on steam locomotive design, the condensing turbine locomotive, and the high pressure water tube boiler type locomotive, of which the "Horatio Allen" of the Delaware & Hudson is a typical example. Comments were made on the McClellan water tube fire box locomotive on the New York, New Haven & Hartford and the possibilities of high pressure locomotives.

Part two of the report was devoted to a summary of developments on the internal combustion locomotive. It stated briefly the characteristics of the heavy oil engines and the various problems connected with the application of Diesel power to locomotive service. The report confined its summary to the developments in electrical and geared transmission. It concluded with a discussion of the advantages and disadvantages of the oil-electric locomotive.

The report was signed by H. T. Bentley (chairman), C. & N. W.; H. A. Hoke (vice-chairman), Penna.; A. Kearney, N. & W.; George McCormick, S. P.; W. L. Bean, N. Y., N. H. & H.; C. B. Young, C. B. & Q.; M. F. Cox, L. & N.; W. I. Cantley, Lehigh Valley; C. E. Brooks, C. N.; G. H. Emerson, B. & O.; H. H. Lanning, A. T. & S. F.; A. H. Fetters, U. P.; M. C. M. Hatch, M.-K.-T.; S. Zwight, N. P., and R. M. Brown, N. Y. C.

Discussion

The greater part of the discussion of the report of the committee on locomotive design and construction was devoted to the McClellon firebox locomotive. V. L. Jones, New York, New Haven & Hartford, outlined briefly the history of the development of this type of firebox. The New Haven purchased two locomotives equipped with McClellon fireboxes in 1916, he said. These two locomotives went into the shop in 1920 at which time the back head and the bottom of the combustion chamber tubes were rebuilt and the locomotives replaced into service. Since then they have been in continuous operation, including the period during the strike, with a total expenditure of about $300 for maintenance.

Mr. Jones said that the difficulties encountered in the back heads of the original locomotives were overcome in the new design by providing separate braces and taking away from the tubes any other duty except to carry water and steam, and so placing them that they were able to expand and contract without interfering with the firebox strength in any way. In order to avoid bringing in too many new features on one locomotive, the new features were confined to the firebox construction. The designers did, however, he said, take advantage of the water tube construction and raised the pressure up to 250 lb. That necessitated stiffening up the rods and also required some modification of the valve gear so that the valve motion in full gear cuts off at 70 per cent of the stroke instead of near 90 per cent. No provision was made on this locomotive for auxiliary starting ports, and up to the present time, Mr. Jones said no difficulty has developed from the locomotive being slippery in getting out of holes with a heavy train.

Replying to a question as to the time required to wash a boiler equipped with a McClellon firebox, Mr. Jones stated that this work could be done a little quicker than on boilers of the ordinary type. Scale does not accumulate as rapidly on boilers of ordinary construction, he said, possibly due to the rapid circulation which has some scouring action.

The question of high boiler pressure also received considerable discussion and in this connection, the new locomotive, "Horatio Allen" of the D. & H., received considerable attention. G. S. Edmonds, Delaware & Hudson, stated that the total amount expended for maintenance on the boiler of this locomotive did not exceed $50, and that it required a little longer time to wash this boiler than that of the ordinary type. Until recently it was the practice to blow out the flues at each end of the run, he said. An experiment was made, however, in which the locomotive was run for one month without blowing out the flues. They were then washed out. This practice was carried out for a month or two and then instructions were issued not to blow or wash out the flues until the indications showed that it was necessary and these flues have been run three months without blowing. It has been found that this locomotive carries water equally well, if not better, than the normal locomotive. The highest normal operating speed for the "Horatio Allen" is 25 miles an hour with the limitation of 30 miles an hour. Mr. Edmonds also stated that notwithstanding these speed limitations which are strictly adhered to, this locomotive gets over the division much more rapidly than the other locomotives.

One of the speakers brought out the point that in all probability there should be no difficulty in using a double expansion engine such as the "Horatio Allen" with pressures as high as 350 lb., but when the pressure gets up into the range of 600 lb. to 1,200 lb. pressure, it was necessary to consider the utilization of a multistage engine and also to utilize those devices which would reheat the steam between stages as well. This, of course, means severe complication.

The opinion was also expressed that higher superheats are needed. One of the speakers who had some correspondence with the technical department of a locomotive building firm in Germany stated that this firm considered 660 deg. F. as a necessary steam temperature. In this country, the average temperature of 200 lb. pressure steam is 387 deg. F. By adding 300 deg. F. as recommended by the committee, a total of 687 deg. F. will be obtained

which is somewhat higher than the recommended German practice. It was suggested that the superheat of 200 deg. F. as recommended by the committee should be defined, whether an average or a maximum.

The chairman of the committee in replying to these remarks stated that to-day we are buying locomotives with supposedly 200 deg. F. of superheat, but are not getting over 135 deg. of superheat on an average, in freight service. The committee in pointing out that a higher degree of superheat than 250 to 300 deg. F., should be considered, was trying to indicate that at least 100 deg. more than has been obtained in the past should be the desired goal. The committee, he said, did not figure that this 300 deg. of superheat should be obtained by increasing the smokebox temperature abnormally, believing that good combustion means a smokebox temperature of probably 550 deg. F. and in addition, that the average superheat should come up to 225 deg. or 250 deg. and the maximum may go even as high as 350 deg. without any serious trouble.

In closing the discussion on locomotive development, one of the speakers advised the use of superheat at as high a temperature as lubrication will permit, because even though adding 100 deg. to the customary 200 deg. of superheat may increase the temperature of the exhaust steam 50 deg., there will still be a gain in efficiency because of the greater initial volume of the steam.

In the discussion of the sub-committee's report on water columns, it was suggested that the lugs of the water column shown in the drawing be changed from the horizontal hold type to the vertical hold type, as a number of the roads have experienced considerable trouble with the shearing of the bolts. As the recommended column was heavy, it was thought that the usual ½-in. or ⅝-in. bolts would not stand up. It was also suggested that as the bottom connection of the design shown was likely to be stopped up if any sludge accumulated on the bottom of the column, it might be preferable if that connection were made in such a way as to provide a mud pocket below the lower connection.

The point was also brought out that the manufacturers still have something to work out in connection with the construction of a force feed lubricator as none of them seems to have taken any definite steps toward providing an automatic means for controlling the temperature of the oil. This will have to be done before the force feed lubricator will become an ultimate success.

It was moved and seconded that the report be received and that the committee be continued for another year. The motion was carried.

Report on electric rolling stock

As a preface to last year's report, the committee offered under the title of Outline for Future Work, a general discussion of the economies of electrification as applied to existing steam operated railroads. Among the things exploited was the place held by the locomotive in railroad service with the possibility for more intensive operation and greater availability for service from motive power when proper study, planning and methods are applied. With that thought in mind it is well to consider means for obtaining maximum utilization.

A complete consideration must also include terminal electrification and the relative advantages of multiple unit train operation as compared with locomotive operation where such equipment is adoptable.

When the performance records of steam locomotives are reviewed over a considerable period of years with respect to availability for service, there seems to be indicated a retarding influence contemporary with the development of refinements and the increase in haulage capacity. These performance records further indicate that, whereas, the simple type of steam locomotive, as used some 25 years ago, was available for service approximately 75 per cent of the time, the modern steam locomotive seldom produces an average greater than 45 per cent. While obviously the addition of appurtenances and refinements, all of which improve the operating performance of the unit, will increase the amount of attention necessary to keep the locomotive in running order, yet, the decrease in service rendered cannot all be charged against such refinements. It would seem likely that a large percentage may be due to neglect in providing shop and terminal facilities in keeping with the requirements of the improved and larger power. Or perhaps the high percentage of unserviceable time may be due to a deficient understanding of the possibilities of the modern locomotive with its larger grate area, boiler dimension, general increase in proportions, and therefore greater margin of capacity as compared with designs of former years. Were these possibilities fully appreciated, then there would seem to be no logical reason for not providing and utilizing those facilities necessary for the prompt performance of shop and terminal work and thus obtain the maximum mileage performance between shoppings or terminal attention. Again precedent oftentimes places unnecessary restrictions on the realization of the wider range of service capacity of the modern locomotive, particularly where it is operated on the same division with power of a less recent design.

While it may appear inappropriate to dwell on deficiencies of the steam locomotive, nevertheless it is upon these deficiencies that great stress is placed by the proponents of electrification when the latter is under consideration. Such deficiencies should be taken into consideration by any road contemplating electrification and it seems only proper that cognizance be taken of them in this report. An outstanding advantage of the electric locomotive is the high percentage of serviceability as compared with the steam locomotive. Yet we cannot consistently compare them from this standpoint, unless provision is made for full utilization of the serviceability of which the modern steam locomotive is capable.

The steam locomotive of today is the product of many years of development with the view to simplicity and reliability with the result that the attainment of efficiency has been more or less sacrificed to that policy. Test locomotives have been built and successfully operated, under favorable conditions, whereby, through the utilization of stationary power plant practices, very high efficiencies have been obtained. However, it is quite doubtful that such types will become common, because the maintenance problem presented will greatly offset all other advantages. Generally speaking, the average thermal efficiency obtaining from steam locomotives is little greater than one-half that obtained by the operation of electric locomotives on power generated at first-class stationary plants, properly operated, and the advancement in this respect is more pronounced in the latter than in the former, because of the more favorable conditions. Restrictions as to space is not a factor, skilled operators may be employed with the view to obtaining high thermal and mechanical performance, and refinements in equipment may be instituted since the problem of maintenance does not exist in the same degree as in the case of the locomotive. The possibilities for high thermal efficiencies are very much limited in the case of steam locomotives; the opportunities in this respect are in nowise restrained when applied to stationary power plants of considerable size. However, it should be said in passing this point that the possibilities for sustained service with steam locomotives have not yet been attained and it can be said further that were the inauguration of a group of modern engines within a certain section attended with the same engineering skill and given the same support as is done when electrification is set in operation the results obtaining might prove more competitive with the electric power.

The trend of development for stationary power plants in the future undoubtedly will be toward higher initial pressures and temperatures with the object of obtaining higher thermal efficiencies. Such a tendency will have its effect upon electrification projects through a lower unit cost of power. This gain in efficiency will offset a part of the transmission losses or for the same overall efficiency, will permit longer transmission lines and in turn, the concentration of larger quantities of power in the individual plant or plants and of course fewer such plants.

As before mentioned, one of the pronounced advantages from electrification is the peculiar characteristic of this type of equipment which enables it to produce, under favorable surroundings, almost continuous service. Therefore, in laying plans for electrification, full recognition should be given this feature and traffic divisions, for one thing, should be so arranged as to permit long runs, or at least, continuity of runs that will make it possible to gain this advantage. Long mileage of electrified territory is, of course, favorable, but similar results can be accomplished by arranging for prompt return of power at the end of short runs.

The establishment of terminals and shop points has a great deal to do with making electrical operation economical. Repair facilities should be centralized in as few points as possible thus eliminating multiplicity of shop equipment and permitting the concentration of skilled workmen with a minimum capital outlay. Centralization of repairs within certain limits will react on the operation of the equipment to the extent of keeping it on the road,

whereas, with a shop too convenient there is always a tendency to hold the locomotive for minor repairs that can readily be handled at the inspection points. Electric locomotives are not subject to many disorders customary with steam power and in consequence repairs are not necessary at intermediate points. The terminal should be merely a dispatching point where but little work is done other than the ordinary running terminal inspection and such minor adjustments as may be found necessary. There is small need for machine tool equipment at terminal points, but it is advisable to have a liberal stock of small parts in order to make replacements when needed. Trains should be dispatched promptly with a view of keeping the power on the road with as little lost time at the terminal as possible.

Consideration must be given to the cycle of wear of the various mechanical parts and electrical equipment within each unit of motive power with a view of repairing or renewing such items as become necessary, thus keeping the locomotive in service for the longest period practicable. In this connection it is recommended that extra parts be kept in stock to the extent of providing major units such as complete running gears, traction motors, track units, etc., thus reducing the total of complete units to a minimum. The same may be said of multiple unit cars as far as maintaining complete major repair units is concerned. The situation is different however, to the extent that ordinarily the equipment reaches a repair terminal on each trip so that the inspection point and repair point in general coincide.

In the routine care of electric locomotives, a difference from steam locomotives is distinctly noticeable. A well designed and operated electric locomotive or multiple unit car, if properly inspected and repaired at periodic intervals, may be run between these intervals without any attention, except such inspection as may be necessary to determine that the car or locomotive is in a safe operating condition. The intervals at which the inspection and repair periods must be set can only be determined by operating experience and a careful study of the individual car or locomotive design, having in mind that careful inspection, with minor adjustments, will frequently prevent the necessity for extensive work. It is, therefore, recommended that facilities for testing and inspection of electric locomotives and multiple unit cars at periodic intervals be developed to a high degree, in order to obtain perfection in the operation, and thus reduce detention and intermediate inspection to a minimum.

Fullest utilization cannot be obtained, unless there is full cooperation between mechanical and transportation departments. The successful adoption of electrification requires a full understanding of its peculiar characteristics by all concerned. Educational measures should be inaugurated for this purpose and means for adequate instruction should be instituted sufficiently in advance that those having direct charge of the equipment may be fully acquainted with electrical matters and thus be able to handle the equipment in the best possible manner.

Where practicable, there is a great advantage in using locomotives of the same type for all services within a given district or territory. It will lend greatly to the flexibility of service, reduce the multiplicity of repair parts and operations, and be a large factor in gaining sustained service.

Official classification rule covering movement of gas and electric cars on their own wheels

During the year a special assignment was given the committee to study and recommend changed wording of Official Classification Rule No. 47. The rule now reads as follows:

Gasoline or electric motor cars, on their own wheels, gear wheels disconnected: Actual weight less fifty (50) per cent with a minimum net weight charge of 36,000 lb. each 5

Actual weight subject to minimum weight of 30,000 lb.

After due consideration of the features involved, the following wording was unanimously adopted as the proper wording of the rule:

Gasoline or electric motor cars, on their own wheels:

1st, *Self Propelled Cars Other Than Electric Driven*: Transmission or driving rods disconnected or transmission positively locked in neutral.

2nd, *Electric Motor Cars*: Not to be shipped with motors mounted on trucks:

Actual weight less fifty (50) per cent with a minimum net weight charge of 36,000 lb. each 5

Actual weight subject to minimum weight of 36,000 lb.

It is further understood that:

(a) No reference herein applies to electric locomotives or self-propelled cars shipped over rails on their own wheels and under their own power.

(b) Unless transmission or driving rods are disconnected as provided above, an attendant must accompany all such shipments. In any event it is recommended that an attendant accompany all such shipments.

The Rule as rewritten meets with the approval of both the Westinghouse Electric & Manufacturing Company and the General Electric Company.

Inspection rules

The sub-committee dealing with the subject of inspection rules of which J. V. B. Duer, electrical engineer, Pennsylvania, is chairman, is to continue without instructions until after the American Railway Association completes its conference with A. G. Pack, chief, Bureau of Locomotive Inspection, regarding new Interstate Commerce Commission inspection regulations covering ocomotives other than steam operated.

Shop facilities

As most of the heavier electrification projects have been attempted to handle some certain service condition or capacity, their detail operations have likewise been arranged best to meet the requirements. In consequence, the facilities have somewhat suggested themselves and have grown with the development of the undertaking. At the same time, with the introduction of electric equipment to work with or replace steam equipment, the essential additional features for the dispatching or running repair stations originally laid out for steam are not extensive. In a general way, facilities prepared for steam constitute practically or nearly everything needed for electric and more. At the general repair shops, the situation is somewhat modified and controlled by the type of equipment. In laying out new shops for either dispatching or general repair work, there may be conditions that might be re-arranged to considerable advantage to improve the order of operations and efficiency.

With the change from steam to electric power, it is in some cases more economical to use multiple unit passenger equipment in place of electric passenger locomotives. When this is the case the passenger car terminal repair shop should receive careful consideration, and will probably require a more radical change than that compared with the steam locomotive dispatching terminal.

Multiple unit equipment

There are certain tools necessary for the maintenance of electric multiple unit equipment that must be added to those usually found in steam road passenger car shops. The design of equipment used on multiple unit cars is limited to such extent that the tools and other facilities are practically the same for both direct and alternating apparatus.

The major tools should comprise armature banding lathes, coil winding machines, commutator slotting machines, bake ovens, presses, test apparatus for magnet coils, field windings, separate lathe chucks for boring and fitting up motor and axle bearings and small tools for air compressor and control parts.

Inspection sheds should be provided to handle the required number of cars, and equipped with suitable well lighted inspection pits.

One of the most important facilities required in a well designed back shop is a large crane equipped with special hooks for lifting car bodies off their trucks and placing them on temporary or shop trucks. While most any type of car or locomotive shop would probably be suitable for multiple unit equipment, the output depends entirely on efficient handling of the truck repair work. Therefore, traveling cranes should be provided with sufficient capacity to handle complete trucks. Sufficient floor space should be provided between truck repair tracks for piling of repair material for assembly.

Locomotive dispatching or running repair stations

Treating on the facilities for the terminal handling of equipment in contra-distinction to repairs in connection with dispatching and running repairs, steam equipment essentially requires provision for coaling, cleaning fires and ash pans, supply water, hot and cold water for boiler washing and filling boilers, steam blower to accelerate firebuilding, suitable inspection pits, and a turntable or wye to handle engines for return trips. Practically none of these are necessary for the handling of electric power, except inspection pits, sand supply, water for rheostats, where used, and provision for fuel oil and water for passenger locomotives using a steam boiler for train heating purpose. Consequently, in changing facilities for the exclusive handling of electric power, they may

be materially less than for steam. For the handling of steam equipment, as also applies to electric power, custom practically establishes one of the terminals reached in the course of the daily run or trip as the home or principal dispatching station. At this station, the major part of the running repairs is made, and in the interest of handling the work to advantage and economically, facilities are provided accordingly and in excess of those provided at the other terminals or outlying points. The facilities needed at outlying points for the handling of electric locomotives may be little more than inspection pits, and provision for sand and water supply, depending upon the type of equipment in use.

One idea of the comparison between the inspection and running repairs for steam and that needed for electric locomotives is that the former takes minutes for the inspection and hours to make repairs, while with the electric it takes hours to find the trouble and minutes to make repairs. These figures may be exaggerated, but serve to illustrate the reversal of the conditions.

The actual serviceable time of heavier steam power has been found to be in the neighborhood of 45 per cent as against 85 per cent for electric locomotives. This wide difference in serviceable time is no doubt due in part to the small amount of time required for the work on electric locomotives, in that complete units can be renewed in a comparatively short time. The longer time put on the steam locomotive is accounted for largely by the almost constant attention which must be given to the firebox, flues, stokers, guides, valve gear, reversing mechanism, piston and valve packing and periodic boiler washing and inspection. For electric locomotives inspection pits and means for supplying engines with sand and oil at outlying points are all that is necessary, except where passenger locomotives are handled means should be provided to supply oil and water.

For the handling of steam locomotives at the principal dispatching stations a turntable or wye is generally necessary to turn the power for the return run, and an engine house of the conventional circular form, with its turntable, well supplies convenience for the routine inspection and repair work. Similarly a turntable has been found valuable in connection with a rectangular engine house for the handling of electric locomotives composed of two or more units, and certain units of other types. By having a turntable or wye time can be saved by withdrawing for repairs but one cab or unit of a locomotive composed of two or more units, and the substitution of another cab to make up a complete locomotive, thus keeping the maximum number of complete locomotives in service, and at the same time handling the repairs on the out of order cabs to the best advantage. In making such exchanges and also to equalize flange wear, it often becomes necessary to turn a cab end for end.

Where electric power has been put in the field replacing steam either partially or completely, the complements of tools needed at the principal dispatching stations will be largely governed by the type of steam and electric locomotives used. Different methods of handling the running gear work at the outlying and principal stations in conjunction with operating conditions, set up problems that must be worked out or adjusted by the railroad to best meet the requirements.

A working pit supplied with a suitable drop pit for wheel and truck work is a convenience that might be considered common to steam as well as electric power, and is as convenient at the general repair shops.

An overhead crane of greater capacity perhaps than used ordinarily at a steam locomotive roundhouse is practically a necessity, for lifting motors, transformers, rheostats, air compressors, and other heavy parts of the electrical machinery from the frames, either through the hatch in the cab roof or after the cab has been removed.

The tool equipment must be distributed between the principal dispatching station and back shop, depending on the distribution of the repair work between the principal dispatching station and back shop as well as on the relation of the shops and whether the principal dispatching terminal is constructed in combination with the back shop or as separate shops located some distance apart.

To handle the work on electric equipment at the dispatching station comparable with the work that would ordinarily be necessary on steam equipment the demands are nevertheless different, and the conditions might be better pictured by considering that in place of the locomotive boiler, steam cylinders, guides, crossheads and valve gear on the steam locomotives, the electric locomotive carries motors, phase converters, control apparatus, rheostats, switches and relays. In place of the steam locomotive cross head, certain types of electric locomotives have the jack shafts, gears or spring quills through which the power of the motor operates the locomotive. On an electric locomotive having the same general type of steam locomotive frame and wheel arrangement, the driving boxes, shoes and wedges, and brake rigging are practically the same. The side rods on an electric locomotive are practically the same as on the steam locomotives.

For electric locomotives having gear drive and motor armature mounted on the driving wheel axle, the maintenance work on the gear in a general way takes the place of operations corresponding to side rod maintenance. However, the total equipment necessary may be different.

The machine tools required at a steam locomotive dispatching station to maintain such parts would be practically the same for electric, and in the interest of handling the work to advantage, it has been found convenient to have at the principal dispatching stations tools such as a boring mill suitable for driving wheel centers and tires, a lathe of sufficient capacity to swing the largest motor revolving part, a 24-in. lathe, an intermediate size lathe for smaller motor repair work, a radial drill press, a slotter, vertical drill press, horizontal boring mill for bearings and bushings, press for removing and applying motor shafts and shaper, and facilities for repairing switches, relays, instruments, circuit breakers, etc.

For the major repair work which must be handled at shops corresponding to what are generally understood as back shops or shops where general repairs are made, some inexpensive changes might be made in arrangement of facilities and tools in an existing steam locomotive shop for the same general character of work on electric locomotives to improve the sequence of operations, as they differ somewhat between electric and steam power.

The boiler shop equipment can be eliminated, with the exception of a few tools for the rebuilding and repairing of transformers, rheostats, water and oil tanks and small boilers used on electric locomotives in passenger service.

In most steam locomotive repair shops, overhead cranes have been provided of sufficient capacity to lift a complete locomotive. A crane of sufficient capacity to lift a complete electric locomotive or one cab or unit composing an electric locomotive is desirable, where the design permits, though not always as necessary or as useful as for the handling of a steam locomotive. A crane, however, is quite necessary for the lifting of certain electric parts such as motors, transformers, phase converters, rheostats, and other heavy parts from the frames either through an opening cut in the roof of the cab, or after the cab has been removed. Under the crane should be provided a well lighted working pit, supplied with a suitable drop pit for driving wheels, removing main motors, truck, brake rigging work and similar work on the running gear.

There are many tools in use in the steam locomotive repair shop that might be well utilized in the maintenance of electric equipment, although on account of some of the electrical apparatus being rather special, there may be a demand for a greater number of small tools of special arrangement and design in order to handle small parts of motors, switches, blowers, etc. For instance, a boring mill for driving wheel centers and tire work, a lathe of sufficient size to swing the largest armatures or motors, small as well as intermediate size lathes, a radial drill press, a vertical drill press, a horizontal boring machine, a planer, a shaper and a driving wheel press should be provided. Lathes ordinarily used for piston work can be used for small motor shaft work. The smaller lathes and shapers can be used on a quantity of smaller electrical parts; maintenance of air compressors, dynamos, air brake work and other auxiliary units forming a part of the electric locomotive.

In addition to the equipment usually found in a well equipped locomotive shop, facilities must be added for armature banding, coil winding, press for handling armature shafts, etc. The armature and control repair department should, if possible, be conveniently located adjacent to the machine shop in order to make the best use of the crane service and minimize the re-handling of motors and especially armatures on motors.

As a rule, existing steam locomotive shops, with some slight rearrangement of facilities, are very adaptable for the care of electric locomotives. There are, however, great possibilities for economies in labor and time where new shops are designed for the exclusive care of electric equipment. A definite layout or

complement of tools cannot be prescribed, as both depend entirely upon the general design of equipment used.

Electrification progress

Progress made in the electric traction field during the past year was included as Exhibit No. 4. The new types of motive power units built were commented on and a large table included which lists electric traction installations used in all the principal countries of the world. This table includes a group of pertinent facts which characterize each installation.

A report listed as Exhibit 5 compares the relative advantages of the multiple unit system and electric locomotives for passenger service.

On motion, the report was accepted and the committee continued.

Committee on car construction

In connection with this report, attention is directed to the samples of cars and car equipment, displayed to illustrate features included therein.

The various subcommittees have done excellent work, especially that on box cars with wood sheathing and lining, and that on fundamental design calculations. The last mentioned report could not be condensed without loss of valuable information, for which reason it is included complete, as an appendix to this report.

Standards and alternates

For the purpose of simplification, and to avoid misunderstandings it was decided that only one design of complete unit or detail, not patented, if possible, would be used to illustrate a standard or recommended practice. Any other designs, either shown or implied, would be known as acceptable alternates.

A note will be included with the drawings or specifications for same to govern cars built from the design, reading as follows:

Anything that is shown on the drawings as alternates, indicates that such alternate is equal to that shown, as standard or recommended practice, in strength, service, and interchangeability, and, therefore, acceptable.

It is to be understood that the committee designs establish fixed conditions, permitting the use of detailed designs standardized by the association, or the substitution of other parts preferred by the individual railroad, singly or in groups, provided these parts, or groups of parts, are the equivalent in strength, service, and safety of, and interchangeable with, the standard part or group of parts replaced.

The subcommittee on Car Designs have adopted rules governing the size and marking of tracings which will be followed in the future.

Trucks

The general plans show the frames adopted as recommended practice, with minor unimportant modifications, to facilitate foundry work.

The side frames, with boxes cast integral, have been shown as representing recommended practice. The Andrews type and special box type, also cast or built-up types, which will meet design and specification requirements and are interchangeable, are acceptable alternates. The special box types have been previously shown, but new tracings, incorporating the slight modifications for foundry practice, made in the integral box type frames, will be made for the manual.

The bolsters illustrated conform closely to those now in the manual and to the present A. R. A. fundamentals. Other bolsters meeting the design and test requirements are acceptable, if interchangeable.

The bolsters now in the manual do not conform to the standard fundamentals, which makes them obsolete. It is, therefore, recommended that they be withdrawn, and the new bolsters substituted therefor.

The subcommittee on Trucks is investigating what changes are required in the standard arch bar design, to meet the design and specification requirements referred to.

To provide truck frame information, as complete as possible, a subcommittee on Frame Tests is preparing to test A. R. A. and U. S. R. A. frames in three ways: First, on screw-operated static test machines, with both vertical and transverse loads, in conformity with the proposed specifications; second, on the American Steel Foundries Company dynamic test plant, and, third, on the Symington dynamic test plant. It is expected that a summary of these tests, and an analysis thereof, can be presented next year.

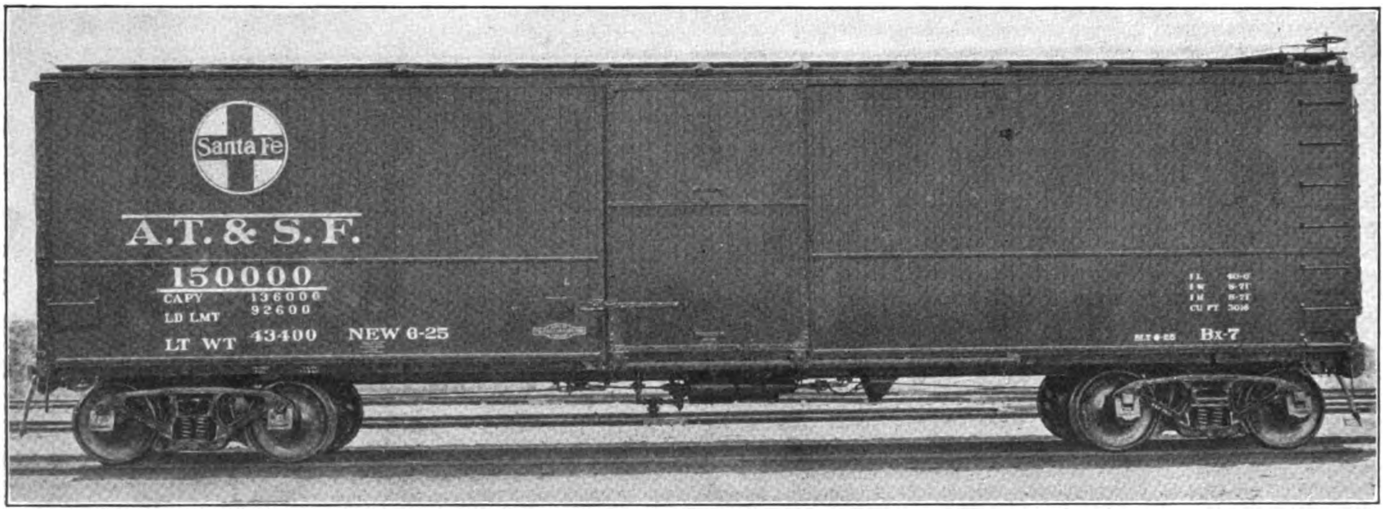
Designs for standard cars

Single-Sheathed Cars—These designs, including specific modifications, were adopted as recommended practice. New tracings are being prepared to include the modifications, and will be available later in a supplement to the manual.

Steel-Sheathed Cars with Wood Lining—The committee was instructed to await service results of those already built before resubmitting this to letter ballot. Nothing further has been done with this design.

Steel Frame Cars with Wood Sheathing and Lining—These designs, covering cars of 40 and 50 tons capacity, have been carefully considered by a subcommittee, and are presented for adoption as recommended practice.

These designs include the changes in the original fundamentals, which were adopted by letter ballot vote on the single sheathed car. The fundamentals and general specifications for A. R. A. box cars, as shown in the manual, have been observed throughout.



Double wood sheathed 40-ton box car, class 4C-XM2, with proposed standard lettering and marking

1—In accord with the modifications adopted by the association for the single sheathed car, the length over striking castings has been reduced from 42 ft. 6 in. to 42 ft. 3 in. This was done in order to avoid having an excessive end ladder clearance when a pressed end is used, and reduces the truck centers from 32 ft. 6 in. to 32 ft. 3 in., with a consequent reduction of ¼ in. in the width of each truss panel.

2—As recommended by the subcommittee on Fundamentals of Design, the crossbearers have been relocated at the door posts, instead of at the intermediate posts.

3—A combined striking casting and front draft lug has been designed to replace these two details. This results in a saving of 6½ in. in length of center sills.

4—A new corner construction has been developed for this car, using a 3½ in. by 4⅛ in. by 3½ in. Z-bar for corner posts. This construction permits of the use of either the A. R. A. standard steel plate end or a pressed end, with the same corner post. The pressed end construction with its constituent parts, i.e., end sheets, end plate, side and end plate construction, end sill and push-pole pocket, taken as a group, is interchangeable with the A. R. A. end plate.

5—In order to avoid cramping the hand brake rod where it passes through the bolster diaphragms, it was necessary to redesign the body side bearing brace so that the hole for rod could be moved further from center of car. A casting was substituted for the pressing shown for single sheathed car.

6—The design of the side door has been changed to give more substantial construction.

7—A door track has been added to bring the roller more clearly over the center of gravity of the door. This track is a 1¾ in. by 1¾ in. by 1¼ in. by 1¾ in. Z-bar and serves also as a guide. A bottom supported door can be used without disturbing this top guide, and the bottom guides and the side sill filler supports are so arranged that the track for the bottom supported door can be applied without any additional punching of holes in the side sill.

8—In order to increase the ease of operation, the door hanger has been redesigned, using a 3½ in. instead of a 2½ in. roller.

9—The latitudinal running board supports have been redesigned so that the same support can now be used with either the outside metal roof or the all-steel roof.

10—Due to the location of crossbearer at the door post, it was necessary to change the brake arrangement. The cylinder and reservoir were moved 3 in. toward the center line of car. Various details were also simplified. The K D type of brake arrangement has not yet been developed.

11—The brake shaft was lengthened about 1 in. in order to give 5½ in. hand wheel clearance.

Consideration was given to all suggestions and criticisms received from nearly all members of the Committee on Car Construction, and also from the Railway Car Manufacturers' Association.

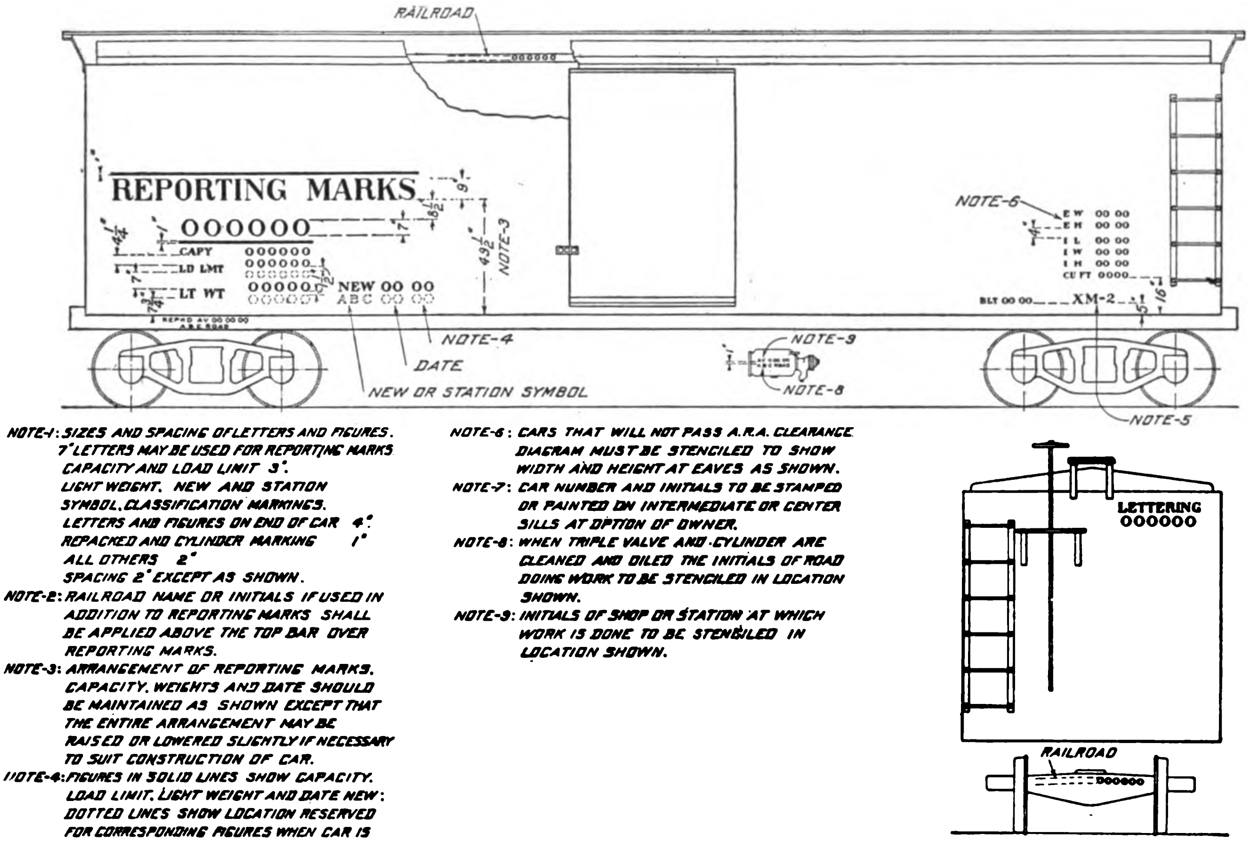
While it has not been practicable to use a number of details of the single-sheathed car on the double-sheathed cars, new details have been developed which may be used on both designs.

We wish to call attention to the method of making the post and brace connections at the side plate. The outer legs of the Z-bar post and brace are turned toward each other, and a plate is riveted on the inside, the rivets being countersunk on the outside to give a smooth surface for the application of the sheathing. The outer legs of the post and brace are riveted to the gusset plate which is flanged at the top, and riveted to the horizontal web of the side plate, instead of to the vertical leg. With this construction, the Howe truss, which is an alternate, may be applied without any interference with the carlines on the outside metal roof. This construction also tends to eliminate the eccentricity in the posts.

The subcommittee will prepare a Safety Appliance drawing for publication in the Manual after the Interstate Commerce Commission representatives have had an opportunity to inspect the sample cars and criticise the application of safety appliances. Any suggestions the Commission may make can then be incorporated in the drawing.

Fundamental calculations

In the absence of reliable information covering strains or stresses exerted on cars, and methods of calculation to design parts to



Proposed standard lettering and marking of box cars

resist such strain in the car body, it was deemed desirable to appoint a subcommittee of experts in this work to furnish a complete synopsis for our future guidance. This subcommittee, after a large amount of very painstaking and careful work, has produced a valuable addition to the available information on car design. Their report is given in an appendix.

Specification fundamentals

One of the functions of the committee on Car Construction is to indicate fundamentals on which specifications should be prepared. The trucks and other important car parts can best be safeguarded by specific designs and tests predicated on standard fundamentals. The test should prove the correctness of the design.

This committee will, from time to time, present for approval such design and test requirements, and now submit for adoption as Recommended Practice, Design and Test Requirements for Truck Side Frames and Bolsters, also Coupler Yokes. These have been fully discussed with the representatives of the manufacturers.

It is recommended that, after the adoption of these requirements, the committee on Specifications and Tests be instructed to prepare the necessary detail specifications.

Side Frames and Bolsters—They may be either integral or built-up. The maximum combined unit stress in the design shall not exceed 16,000 lb. per sq. in. The basis of design shall be one axle capacity=C.

For each side frame the vertical design load shall be taken as acting on the spring base (or its equivalent, for test) and shall be 1½C. The transverse load shall be taken as acting on the bolster guides—one-half on each guide—on a line located above the normal center line through the two axles, an amount equal to the journal diameter of axle less 1½ in., and shall be 0.4C.

For each bolster the vertical load shall be taken as acting on the center line of the bolster, anywhere within 8 in. each side of the center bolster; also anywhere from the center of spring support to a point 23 in. from the center of bolster. The section moduli shall decrease uniformly from the section 8 in. from the center to the section 23 in. from the center of bolster.

The transverse load shall be taken as acting on the neutral axis (or, for test, on a line 5 in. below the center plate bearing face), and shall be applied only at the center of bolster.

For calculation of maximum combined unit stress, the vertical load shall be equal to P, as given in the table, and the transverse load shall be 0.25P.

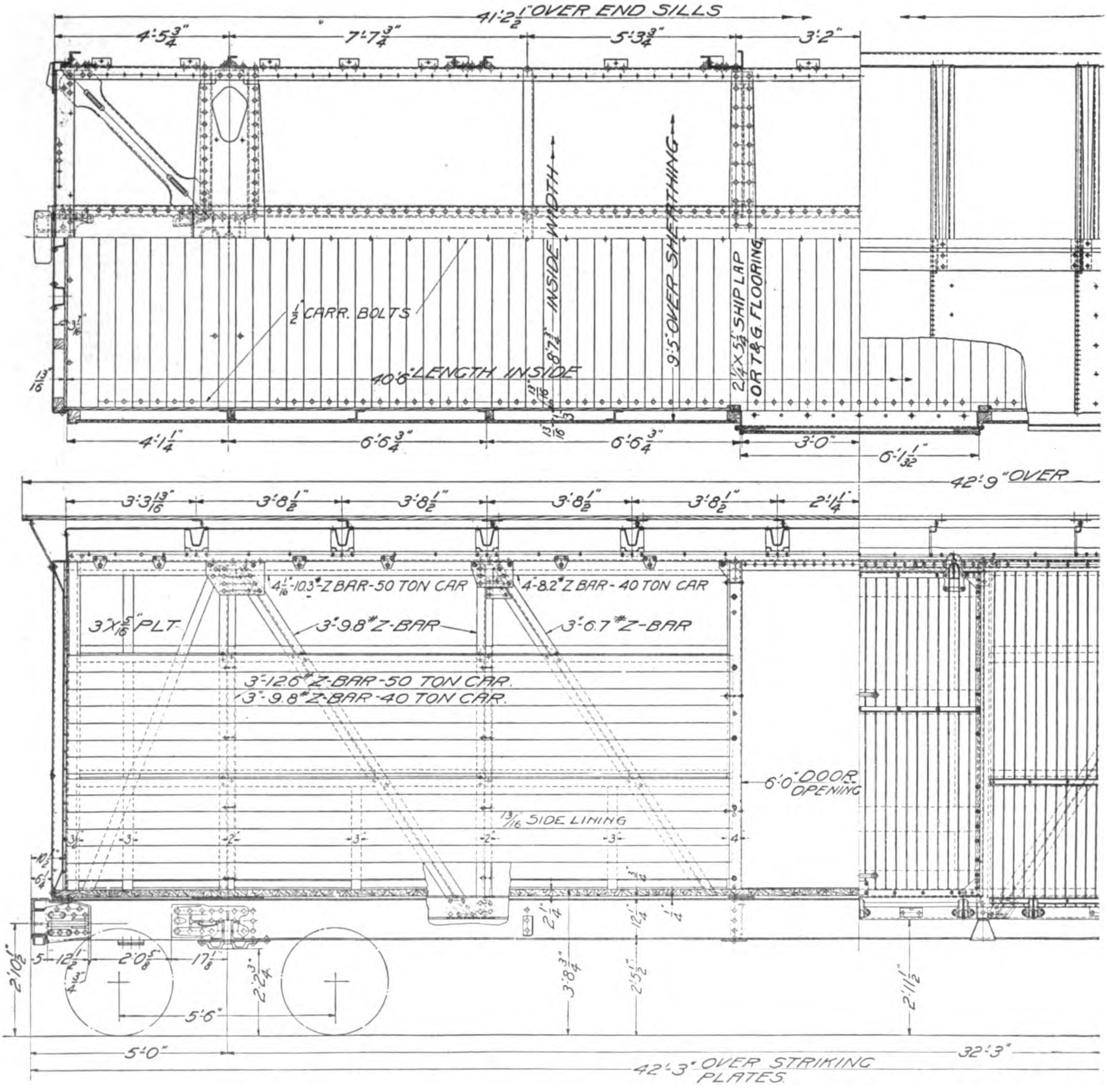
The maximum unit stress for vertical or transverse loads, considered separately, shall not exceed 12,500 lb. per sq. in. for vertical load=P, or horizontal load=0.8P.

The values for P are as follows:

Truck	P
2C	62,000
2D	77,000
2E	96,000
2F	115,000

Test load requirements

	Side Frame		Bolsters	
	Vertical lb.	Transverse lb.	Vertical lb.	Transverse lb.
Initial load or zero reading........	5,000	5,000	5,000	5,000
Load at 0.063 in. max. deflection...	2.25C			
Load at 0.075 in. max. deflection...			1.5P	1.00P
Load at 0.094 in. max. deflection...		0.60C		
Load at 0.031 in. max. permanent set	4.50C	1.20C	3.0P	2.00P
Minimum breaking load	9.00C		6.0P	



General drawing of proposed standard A. R. A.

Bolsters shall be accepted if the minimum breaking load exceeds 90 per cent of the tabulated amount.

The vertical loads, "P," for bolster, shall be applied separately, at center plate, and at side bearing.

The deflection measuring instrument shall be located midway between supports of specimen, and shall be set at zero, under initial load.

Coupler Yokes—They shall be made of cast, forged, or rolled steel. Each coupler yoke design, intended for use with type "D" coupler and 6 in. by 1½ in. key, shall meet the following design requirements and tests: If made of Grade "A" cast steel, or its equivalent, the tension area shall not be less than 12 sq. in.; and, if made of Grade "B" cast steel, or its equivalent, the tension area shall not be less than 10½ sq. in. The method of support and loading shall be equivalent to service conditions on tangent track. The maximum set shall not exceed 0.031 in. under a load of 325,000 lb., and the breaking load shall not be less than 550,000 lb. The set shall be taken in the length, from the rear follower bearing face to the front coupler key face. At least two specimens of each new design of coupler yoke shall be tested on a static testing machine.

All standard fundamental A. R. A. requirements not specifically mentioned herein shall also govern.

Truck Springs—Many serious complaints have been made as to spring troubles. The cause of the trouble is due to spring manufacture practices. These practices will have to be revised, at least to some extent. A large proportion of springs examined by micro-photography show decarbonization, on the surface of the wire, to a marked extent, indicating overheating in manufacture. The low stress in springs, when solid, evidently permitted these detrimental practices to develop. Springs properly made can readily be stressed from 25 per cent to 50 per cent higher than according to present practice.

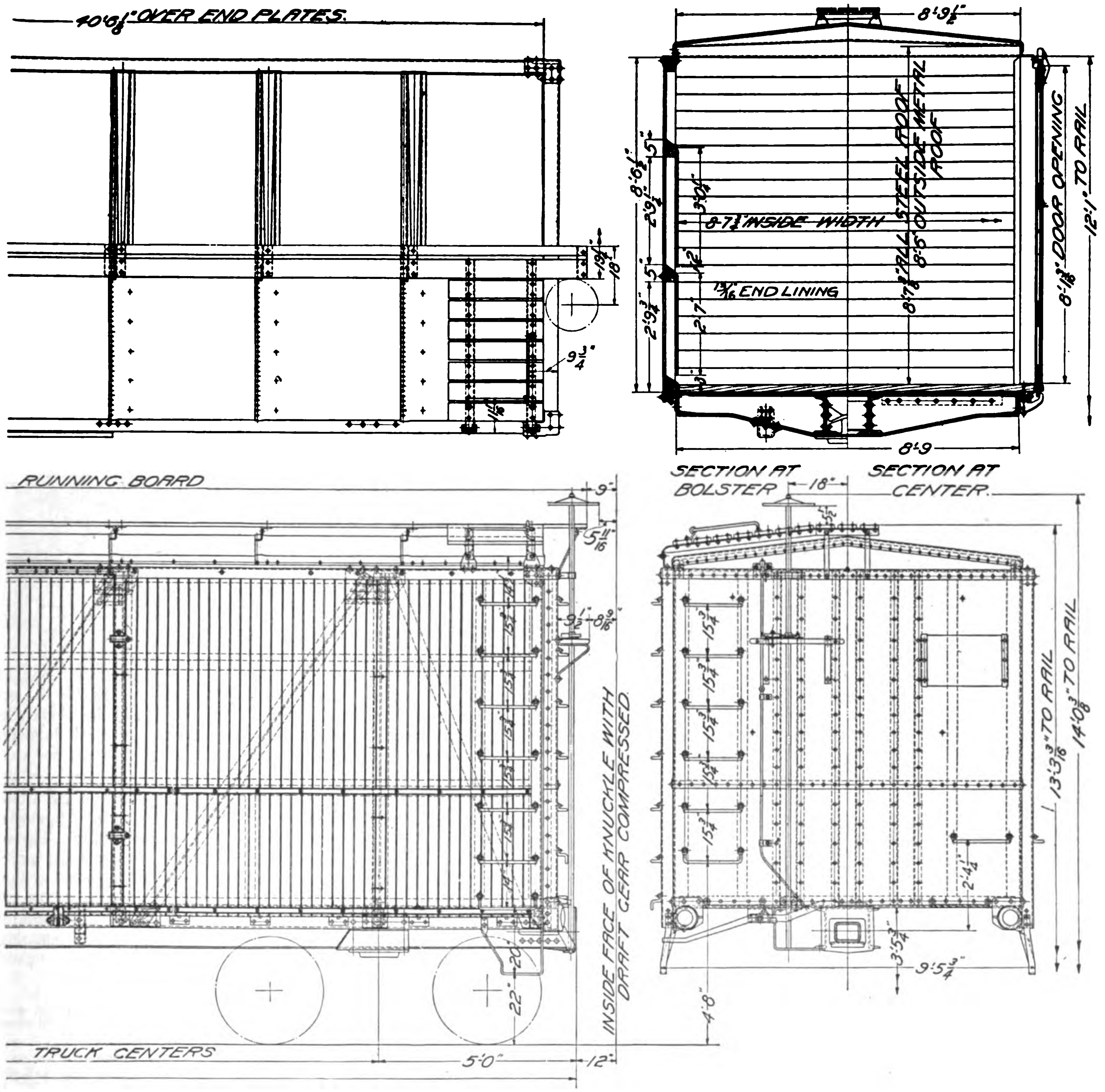
It is unanimously recommended that:

1—The tentative spring designs, class L, M, N, O and P, shown on pages 34 and 35, section D, of the manual, shall be substituted for the present standards shown on pages 27-37, in section D.

2—The tentative specifications for Chrome Molybdenum alloy steel helical springs shall be withdrawn.

3—The standard specifications for carbon steel bars for railway springs shall be modified to require free height not to exceed, and the height under specified load, not to be less than the design heights.

4—The substitution of the present standard 50-ton car springs, as shown



double wood sheathed box cars, classes 4C-XM2 and 4D-XM2

on page 32, section D, of the manual for springs of the new standard 40-ton cars, shall be permitted.

The changes involved in the recommended modifications will make no changes in existing trucks, will incur no increase of stress in the springs under static load, will require no different material either in quality or dimensions; but will materially decrease shock effect, thereby benefiting both the springs and truck frames.

It is recommended that, after the adoption of the above, by letter ballot, when it is referred to the Committee on Specifications and Tests, to prepare the necessary change in the specifications, they should, if possible, include a surface decarbonization limit, and such other photo-micrograph requirements that they deem proper to insure careful heat treatment.

Hatch Covers for Refrigerator Cars—It has been suggested that considerable expense could be avoided if a standard hatch cover be adopted, and all new cars be made to use that standard. A subcommittee made a full investigation of existing cars, and reported that it would be practical to adopt one standard. They submitted a design of hatch opening and cover advising that this design is adaptable to the greatest number of existing cars, without serious modification to the cars, and will be satisfactory for new equipment. Your committee recommends the adoption of this design as a standard of the association.

Corrections.—Attention was directed to an apparent error in dimensions for the gages for the 4¼ in. by 8 in. bearings and wedges. The criticism is justified, and corrections should be made.

box car ends which meet the A. R. A. requirements of section "C," pages 7 and 8, are not as serviceable as they should be; also that comparing ends on the basis of section moduli is not a measure of relative service value, on account of differences in elasticity.

During the coming year a subcommittee will make a thorough investigation of this subject by making a series of tests to destruction of the generally used corrugated ends, and the A. R. A. steel end with vertical posts. The preliminary instructions to the subcommittee include:

1—All tests shall be made on full-size samples, exactly as applied to a car.

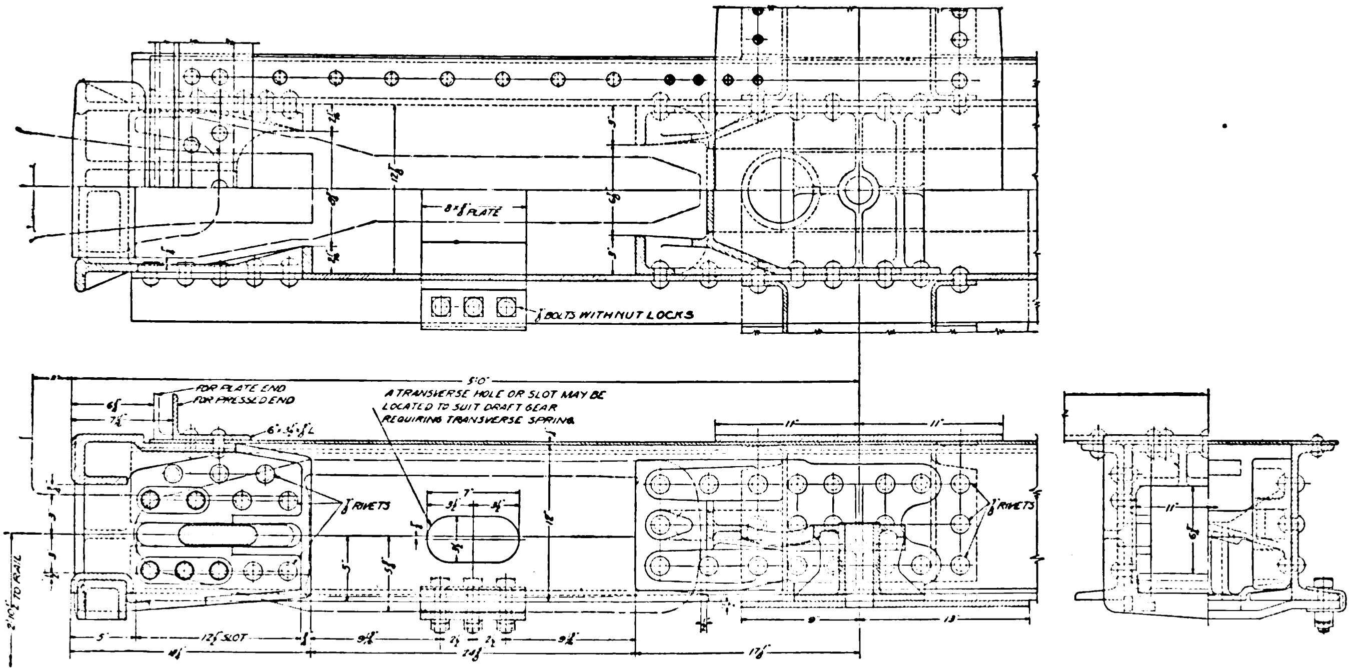
2—Ends to be tested shall be the Murphy corrugated end, and the A. R. A. steel plate end with vertical posts.

3—Ends to be tested shall include the lining and side post construction.

4—The side post construction shall be the same as used on the car, and so reinforced that these posts are not subject to material deflection.

Axles—It was requested that the non-standard axles having 4 in. by 7 in. and 4½ in. by 8 in. journals be recalculated on the basis of the A. R. A. formulæ, to determine whether the nominal capacity can be increased. This calculation showed that the axle with 4 in. by 7 in. journals, under a car with a load limit of 87,000 lb., would produce a stress of 29,520 lb. per sq. in., at the hub section. Therefore, the load limit should not exceed 67,000 lb., to meet the unit stress limit of 22,000 lb. per sq. in. For this axle no change is recommended.

The recalculation for the axle with 4½ in. by 8 in. journals,



Draft gear arrangement with combined striking casting and draft lug

We, therefore, recommend the following changes: Section D, page 25, wedge "B," change dimension "D" from 2 11/32 in. to 2⅜ in., and dimension "N" from 4 1/16 in. to 4 3/32 in. Section "B," page 23, wedge "B," change dimension "D" from 2 11/32 in. to 2⅜ in., and dimension "N" from 4 1/16 in. to 4 3/32 in.

There is a similar discrepancy in journal bearing gage, section "B," page 22, for class "F" bearing. The ½ in. dimension, at each end, should be changed to ⅝ in., for the "F" bearing only. We recommend that this be done.

There is a discrepancy in the dimensions of the cap for class "H" spring. To make the correction, we recommend that in section "D," page 33, cap for class "H" spring, the dimensions locating the tests be changed from 3 in. to 3 5/16 in., and that the depression for the bolt be made the same as for capacity for class "E" spring, page 35, section "D."

Gages shown on pages 17 to 21, inclusive, of section "B," of the manual, are still standard. They have been practically superseded by gages shown on page 22 and 23, of section "B," which were adopted as Recommended Practice in 1921. We recommend that the latter gages be advanced to standard, and that the old standards on pages 17 to 21, inclusive, be eliminated.

Box Cars (Progress Report)—The claim has been made that

when the minimum wheel seat diameter is increased from 5⅝ in. to 5¾ in., will meet the unit stress limitation of 22,000 lb. per sq. in. under a car load limit of 116,000 lb. It is, therefore, recommended that for this axle the minimum wheel seat diameter be increased to 5¾ in., and the load limit be 116,000 lb., for cars equipped with such axles.

Lumber for Cars—The United States Department of Commerce, by the Central Committee on Lumber Standards, has been active in producing new standards of dimensions and grading of lumber, for the purpose of eliminating waste by simplified practice. We have been requested to make our requirements for cars dovetail with their proposed standards, as far as possible. A careful review of what we need, and what the Central Committee on Lumber proposes to adopt as standard, has led to the appointment of a subcommittee to handle this subject. It was unanimously decided to instruct the subcommittee to ask for:

1—Lumber dressed to 13/16 in. thickness for lining and sheathing, and, if that cannot be obtained as standard, then request for ⅞ in. thickness (dressed), as standard.

2—Lumber, dressed on one side, 2⅝ in. thick, for flooring.

3—Lumber 2 in. nominal rough thickness, manufactured so that the greatest thickness is obtained when dressed on one side; this lumber to be used where 1¾ in. is now specified for light flooring.

Moisture content in lumber used for cars is of primary importance, and we have been urged to provide a specification giving as low a percentage of moisture as can reasonably be expected under conditions that must be recognized, and at the same time insures the use of material which will not cause trouble from excessive shrinkage. We recommend as a requirement for lumber in car construction the following rules for percentages of moisture content in lumber at time of application to car:

DESCRIPTION	NOT TO EXCEED
Up to 1 in. thick	10%
Over 1 in. and up to 2 in.	12%
Over 2 in. and up to 3 in.	15%
All over 3 in.	20%

For sheathing of single sheathed cars, regardless of thickness, moisture shall not exceed 10 per cent. The moisture remaining in the lumber entering into the car shall be determined by taking as 100 per cent the weight of the test samples, after they have ceased to lose weight.

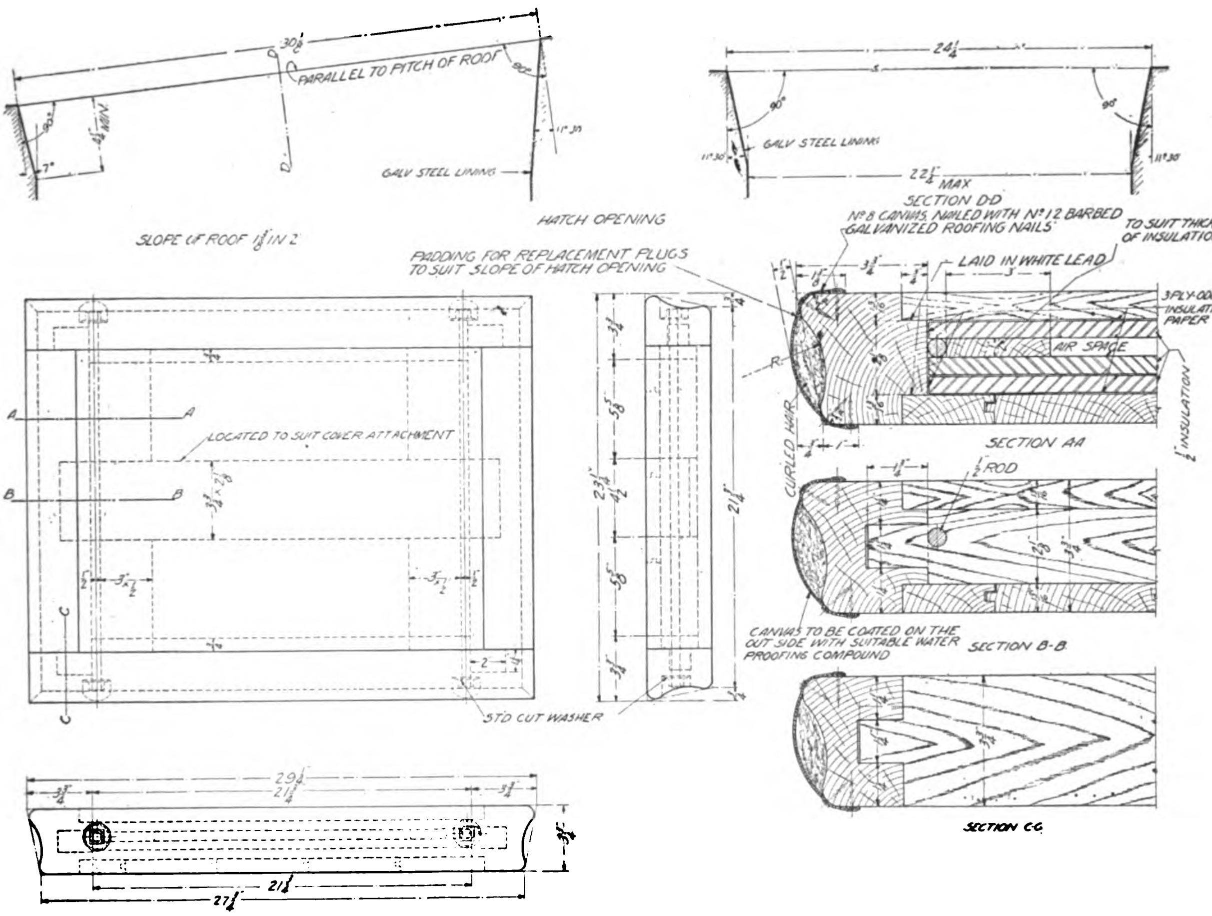
These recommendations, if carried out, will be a move in the right direction to secure better construction, and while the percentages are more liberal than some roads may wish to specify, ance of such material, it is intended to indicate its value, based on the specifications, relative to steel and iron castings.

Lettering and Marking Cars—In developing designs for new cars it was noted that the present standard lettering and marking of cars as shown in the manual includes triple valves, coupler shank, coupler attachment, brake beams and size of journals, all of which parts are covered by Interchange Rule No. 3 for cars built after November 1, 1920, and it therefore appears unnecessary to include such parts in the marking of cars built after that date.

It was further suggested that the markings for length, width and height could be greatly abbreviated and that height and width at eaves would only be necessary for cars that will not pass the A. R. A. clearance diagram.

In connection with Rule 86, the Executive Committee now has before it a recommendation approved by the Transportation and Mechanical Divisions covering capacity, load limit and light weight marking in place of the former capacity and weight marking. (*See report of General Committee.*)

The committee submits with this report a drawing which embodies all of the preceding suggestions and in addition omits the



Proposed standard hatch plug and hatch opening for refrigerator cars

they form a basis for trial that should develop whether further modifications are desirable and are so submitted with recommendation for adoption as Recommended Practice by letter ballot.

Malleable Iron Castings (Progress Report)—Requests have been received that we reconsider the elimination of the use of malleable iron for a number of items embodied in proposed standard car designs.

The standard A. R. A. specifications for malleable iron castings are practically obsolete, since metal produced by this process, at present, would permit minimum requirements greater than those specified.

Our rules now permit the substitution of changes in design and material for those given, provided they are equivalent in strength, service, and safety of, and interchangeable with, those replaced.

As soon as an agreement can be reached with the advocates of the more extended use of malleable iron castings, relative to the best specifications that can be formulated to govern the accept- railroad initials on inside of doors and adds railroad initials on inside of side plate.

The committee recommends the adoption of this proposed marking for:

(A) All house cars built new hereafter.
(B) For repainting house cars built new after November 1, 1920.
(C) Repainting all rebuilt cars which conform in all respects to the requirements of Interchange Rule No. 3 for new cars.

The report is signed by W. F. Kiesel, Jr. (Chairman), mechanical engineer, Pennsylvania System; A. R. Ayers (Vice-chairman), assistant general manager, New York, Chicago & St. Louis; O. S. Jackson, superintendent motive power & machinery, Union Pacific; C. L. Meister, mechanical engineer, Atlantic Coast Line; J. McMullen, superintendent car department, Erie; John Purcell, assistant to Vice-president, Atchison, Topeka & Santa

Fe; W. O. Moody, mechanical engineer, Illinois Central; J. A. Pilcher, mechanical engineer, Norfolk & Western; F. H. Hardin, chief engineer motive power and rolling stock, New York Central; C. B. Smith, mechanical engineer, Boston & Maine; S. O. Taylor, master car builder, Missouri Pacific; Ira Everett, general car inspector, Lehigh Valley; W. A. Newman, mechanical engineer, Canadian Pacific; G. S. Goodwin, mechanical engineer, Chicago, Rock Island & Pacific; F. W. Mahl, director of purchases, Southern Pacific; J. J. Tatum, superintendent Car Department, Baltimore & Ohio; L. K. Sillcox, general superintendent motive power, Chicago, Milwaukee & St. Paul.

Discussion

W. F. Kiesel, Jr. (Penna.), chairman of the Committee on Car Construction, stated that in the design for the double sheathed wood sheathed cars only one type of center sills is shown suitable for vertical yoke. It was agreed two years ago, he said, that center sills suitable for both types of yokes should be shown. In making the design for the single sheathed cars, the same center sills that are shown for the wood sheathed wood lined car and also the center sills for the horizontal yoke, which will be applicable to either one of the other cars, will be used.

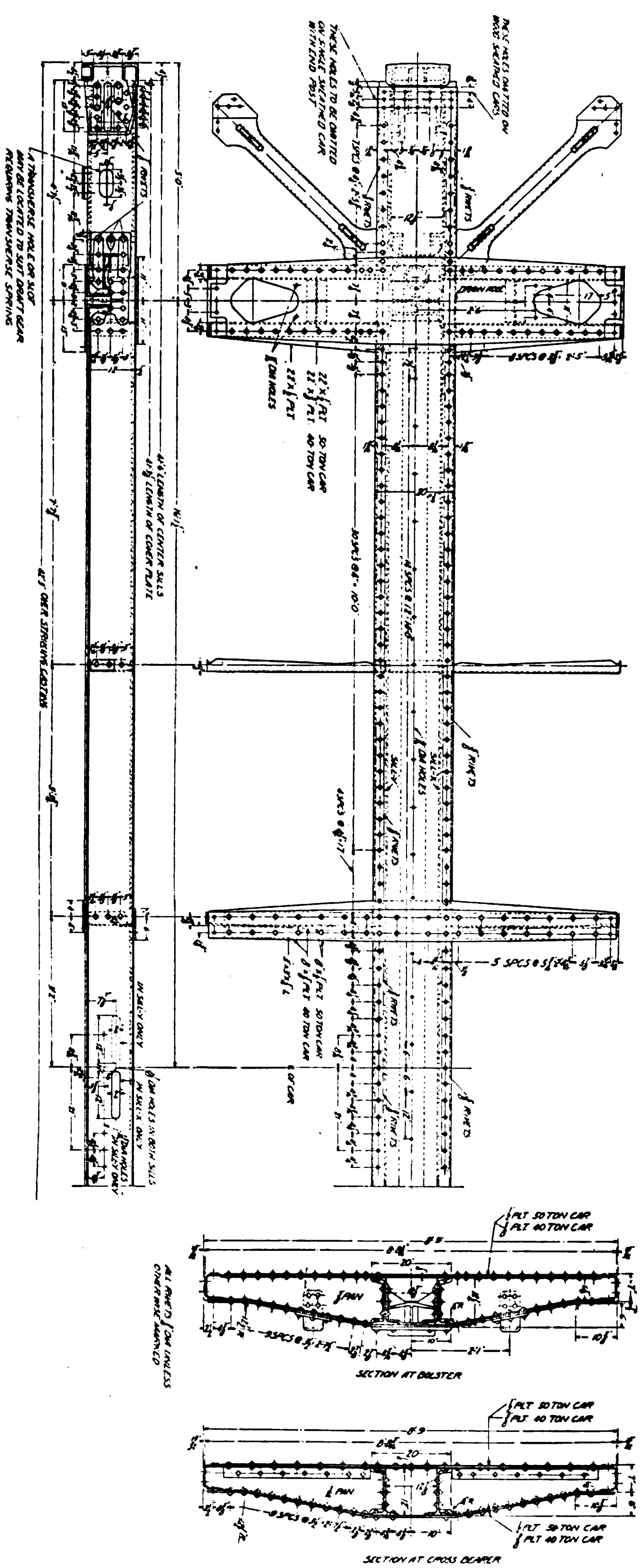
In discussing the strength of the truck frame adopted as recommended practice, J. J. Tatum (B. & O.), a member of the truck sub-committee, stated that it is planned to run comparative tests with 40-ton and 50-ton Railroad Administration side frames and with 40-ton and 50-ton A. R. A. side frames on the Symington testing machine and also on a machine which produces similar tests at the American Steel Foundries, St. Louis, Mo. To overcome the failures of the present A. R. A. arch bar truck, he said that it was thought that the truck sub-committee of the Car Construction Committee might design an arch bar that could be used in repairing the existing trucks so that the weakness of the original design could be overcome and at the same time the additional load that the new Rule 86 and the new marking permits in the car be provided for. Mr. Tatum then referred to the two B. & O. cars on exhibit during the convention, one of which is equipped with a Washburn truck and the other with a somewhat similar truck* which is free from nuts, bolts, washers, keys or pins except for brake pins.

A number of questions were asked relative to the procedure to be used in testing the side frames. It seemed to be the consensus of opinion that the standard A. R. A. static machine as well as the Symington and the American Steel Foundries testing machines should be used, and that comparative tests between the proposed arch bar truck and cast steel side frame trucks should be made.

The point was brought out that the trussed bolsters which had been used extensively on some railroads will not meet the test requirements as specified by the committee. The design with the specifications for side frames and bolsters was made so that under a combined load the maximum stress would not exceed 16,000 lb. per sq. in. This will give a factor of safety of approximately four. Under a direct vertical load it is shown in the specifications that the factor of safety is about six. It was suggested that possibly some modifications in design should be made to find whether or not trussed bolsters could not be made to meet the test limits. If not, and there was a good reason why trussed bolsters should not be subjected to the same specifications, it was stated that the committee would be glad to get any constructive criticisms and, if necessary, produce another specification that would take into account the difference in construction.

One of the speakers in discussing the design of springs recommended in the report, referred to a number of tests made at Ashtabula, Ohio, by the New York Central, with the assistance and co-operation of the Chesapeake & Ohio, the Nickel Plate, the Norfolk & Western and the American Steel Foundries. These tests were made in an effort to discover if possible just what could be expected from a spring of this design. A set of the Class *O* springs was applied to a 70-ton loaded coal car and it was found that the spring recommended as standard did not make a good showing. The Class *O* springs took an average permanent set during the test of 5/32 in. and the indications were that the springs were nearly solid under normal load. Furthermore, the rock of the car body was worse, with a single exception, than with any of the other five types of springs tested, a feature which seemed to the observers to be a serious objection. It was suggested that before the association adopts a new standard design freight car spring, it should have evidence of at least two things: first, that such a spring can be successfully manufactured, and, second, that it would prove to be a better spring than the present standard.

Mr. Kiesel, in speaking for the committee, stated that the stress



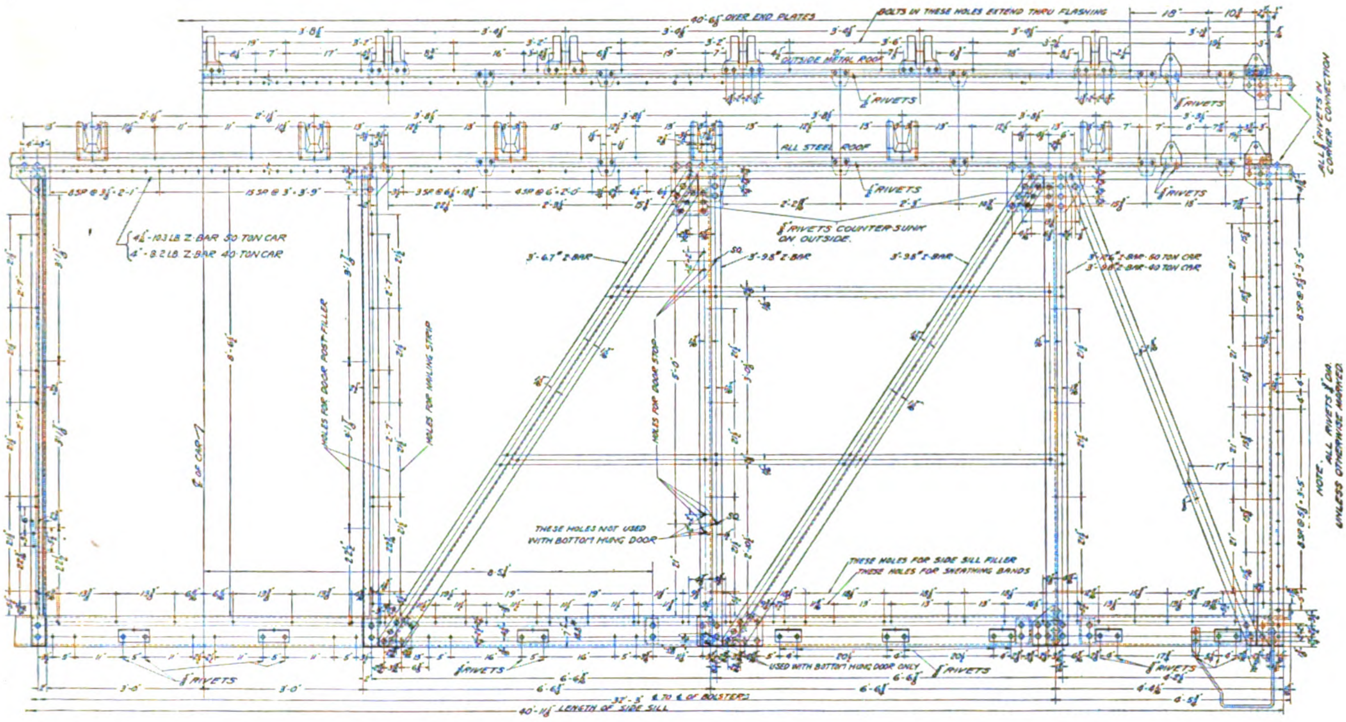
Underframe of proposed standard box cars

for the recommended spring was increased from 80,000 lb. per sq. in. to 100,000 lb. per sq. in., thereby increasing the total possible deflection about 25 per cent and the total capacity about 25 per cent. He did not consider the rocking of the car body as a satisfactory

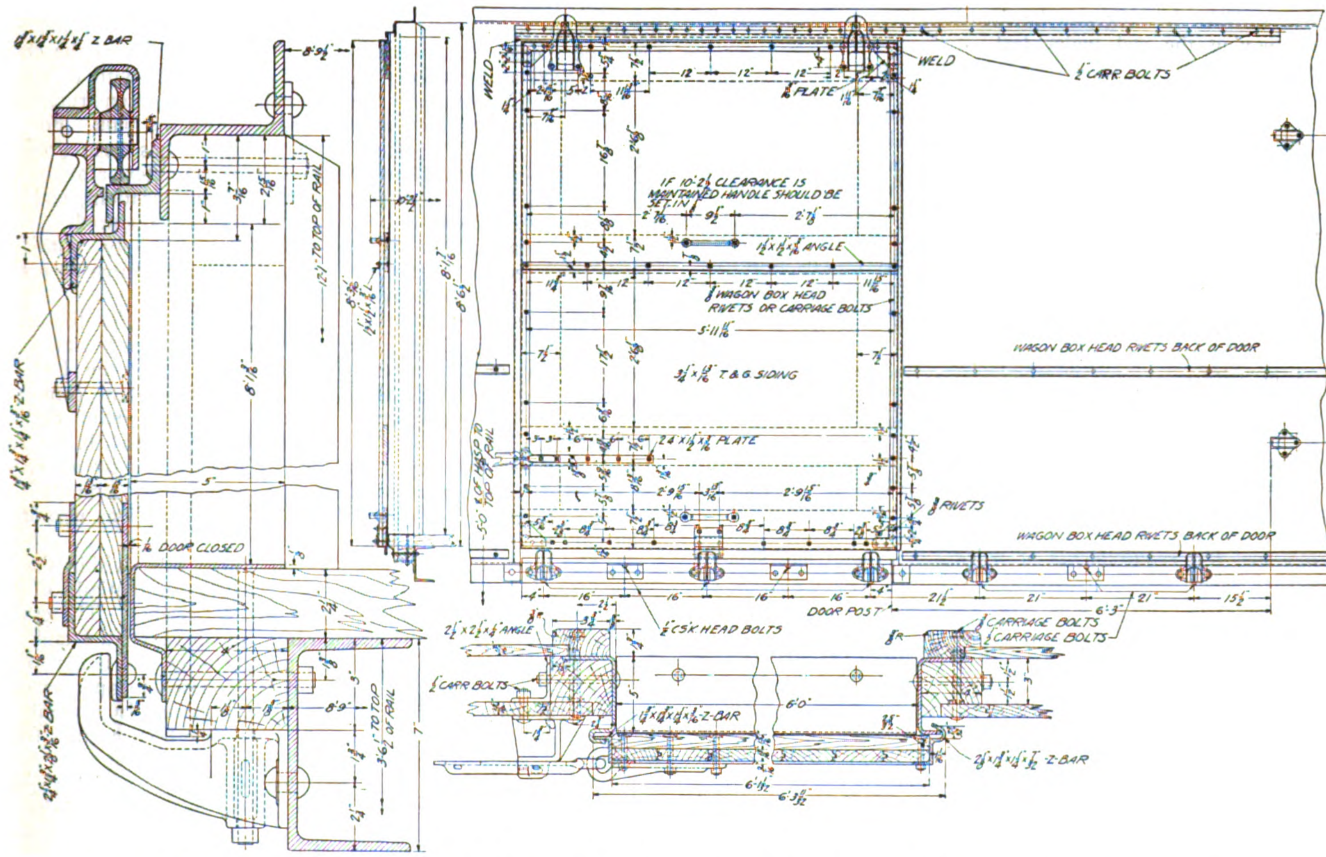
* A description of this truck will appear in a later issue.

gage of the suitability of the spring, the rocking of the car being merely an indication of the flexibility of the spring.

The question of being able to get the springs was also brought facturers cannot do what they are doing now, namely, take a bar, put it in a furnace, take it out when it is white hot and the steel is almost dripping, coil it on a mandrel, dip it in the quenching



Side framing of proposed standard double sheathed box cars



Construction of top-supported side door—Bottom-supported door can be substituted with slight changes

up. Some of the draft gears have springs in which the stress runs about 100,000 lb per sq. in. and up as high as 120,000 lb. per sq. in. Such springs will cost more because the manufacturers will have to heat them more carefully. The present method of manufacture, however, will have to be eliminated. The manu-

fluid and pull it hot and see if it smokes, and then put in the dirt and let it draw itself.

Considerable discussion was devoted to the practicability of substituting the present standard 50-ton car springs on the new standard 40-ton cars, and the possibility of amending the alloy

steel specifications so as to meet the new requirements. The object of eliminating the 50-ton car spring was to permit the use of springs of this type under a lower capacity car. It was the consensus of opinion that there is real need for a spring that will have a proper deflection under maximum loads.

Criticism was made relative to the inclusion of the drawings with a brake head, strut and brake beam in the set of drawings for the car but if that brake beam was necessary it should be referred to the Committee on Brake Equipment. It was suggested that the lug on the strut be marked as optional instead of as shown. The point was also brought out that this set of drawings might be made more beneficial if provisions were made to permit a more extensive application and the use of universally accepted alternates than the limited number now specifically covered thereon.

It was moved that on each principal drawing showing arrangements of draft attachments, striking castings, carrier irons and details, door arrangements, roofs and steel ends, a note be shown stating that any arrangement of draft attachments, striking castings, etc., may be used as an alternate if conforming to the general dimensions shown and approved A. R. A. specifications for strength requirements; that on the drawing showing the coupler release rigging a note be shown stating that any release rigging may be used as an alternate if conforming to the safety appliance laws and A. R. A. code; that in the drawing showing the side truss arrangement a note be shown stating that the Howe truss may be used as an alternate if conforming to the general dimensions shown; that on the drawings showing the trucks, notes be shown stating that trucks of proper capacity conforming to A. R. A. standard dimensions and strength requirements, may be used as alternates. The motion was seconded and carried.

Relative to the subject of box car ends, one of the committee reported that a manufacturer of steel ends had prepared drawings and is manufacturing at the present time a device for testing full size steel ends. The device is in the nature of a trip hammer and has a number of other advantages over types for the reason that it is portable and a blow can be struck at any portion of the steel ends desired or can be struck in a number of places without moving the end under test.

There were some objections to the upper limit of 20 per cent moisture in framing recommended by the Sub-Committee on Lumber for Cars. It was claimed that there is too much moisture to enter into framing members for new cars, particularly refrigerator cars. Dr. W. F. M. Goss read a communication from a committee of the Railway Car Manufacturers Association and a number of lumber producers in which was stated the difficulties involved in kiln-drying various types and sizes of lumber so as to conform to the upper limit recommended by the committee. The following recommendations relative to moisture requirements for lumber in car construction were made for the consideration of the members of the association:

Up to 1 in. thick	not to exceed 10 per cent.
Over 1 in. and up to 2 in.	not to exceed 12 per cent.
Over 2 in. and up to 3 in.	not to exceed 15 per cent.
All over 3 in.	not to exceed 20 per cent.

By action of the meeting the recommendations of the committee on the following subjects were submitted to letter ballot:

Substitution in the manual of bolsters shown in the report.

Proposed standard double sheathed box car.

Design and test requirements of truck side frames and bolsters and coupler yokes.

Hatch covers for refrigerator cars.

Axle.

Lettering and marking of cars (with suggested change in Note 2 of the drawing).

The following subjects were referred back to the committee for further investigation and report:

Tentative spring designs.

Moisture content in lumber.

Report of committee on tank cars

A number of designs of tank cars for special transportation purposes have been approved, the investigation of safety valves, dome covers and bottom outlet valves and connections has been extended and arrangements have been effected with the Interstate Commerce Commission whereunder the experimental application of appliances and appurtenances for tank car use will be made with the approval of the commission.

Approved designs of tank cars

1. ETHYL CHLORIDE CARS.—Application having been made for the approval of a car for the transportation of ethyl chloride, it was determined that, since the general requirements could be satisfied with a car having the characteristics of those covered by the Class IV specifications modified to suit the particular properties of the chemical in question, the proposed cars should be built under a sub-classification of the Class IV specifications.

These cars will have heavier plates and an expansion dome with a capacity equal to four per cent of the combined capacity of the shell and dome. This dome will have a bolted cover. There will also be an additional dome comprising a cast steel nozzle riveted onto the tank proper to which is bolted a standard Class V manhole cover and dome housing and cover.

The expansion dome is provided with two safety valves. In the filling and discharge dome two 2-in. ammonia angle valves are placed, and from one of these a suction pipe leads down into a suction bowl applied in the bottom of the tank. There is no gravity outlet mechanism.

The design is covered by specifications for Class IV-A cars appearing in the report as Appendix "A."

2. PROPANE CAR.—Designs were submitted for a Class V car for the transportation of propane, offering no departure from other cars of the same class heretofore built except that the tank is 85 in. in diameter and the car and contents are said to be heavier than the average car of similar construction now in service. The builders state that the estimated light weight of this car is 86,500 lb. and that the tank is designed for a load of 40,000 lb., or a total weight on rails of 126,500 lb.

No particular problems were presented except with respect to the braking power as to which the Committee on Brakes and Brake Equipment ruled that since the car was of a special type and the nominal braking power with the car loaded provided ample control in general service, the single cylinder 10-in. brake equipment would be accepted.

3. DINITRO-CHLORO-BENZOL CAR.—This chemical is a non-inflammable product which liquifies at low temperature and possesses no special transportation risk. The properties of the chemical are such as to make it desirable that contact with the hands be avoided. Consequently it is desirable that the construction be such as to minimize the necessity for entering the tank. For this reason a special arrangement of heater pipes has been provided to permit the withdrawal of the pipes from the exterior of the car. This car will be built under the Class III specifications, and will be stenciled "For solids only—Pressure test not required."

4. SULPHUR-DIOXIDE CARS.—These cars comply with the specification requirements for a Class V car and involve no peculiarities of design or construction.

5. ANHYDROUS AMMONIA CARS.—Requirements for the transportation of this chemical are satisfied by a Class V car. The transportation of this chemical is now limited by the I. C. C. regulations to metal cylinders, and special tank cars complying with the A. R. A. specifications and having a maximum capacity of 30,000 lb. This material loaded not to exceed 0.54 lb. for each pound of water capacity. Since there appeared to be no reason for objection to shipments in larger quantities your committee offered no objection to an amendment of the regulations permitting shipments to be made in Class V tank cars.

6. MOLASSES CAR.—The design submitted falls within the requirements for a Class III car and consists substantially of two glass-lined seamless tanks supported on steel cradles. The cradles are riveted directly to the underframe, and between the tank and the cradles 2-in. cork is provided; also between the heads of the tanks and the ends of the cradles it is proposed to apply a composition material, completely filling up the space. In general, the design follows those which have for some time been in milk transportation service.

7. NARROW GAGE CARS.—In order to satisfy special requirements for restricted service, the committee gave approval for the construction of certain narrow gage tank cars having wooden underframes required for exclusive service on the Denver & Rio Grande. Approval of the construction was with the understanding that these cars were not to be offered in interchange.

Specifications

Amendments and modifications in the specifications for tank cars are recommended as follows:

1. MATERIAL.—Specifications for Class III cars, section 2.

Paragraph (b) now reads: "Rivets shall comply with the A. R. A. specifications for Boiler Rivet Steel and Rivets for Passenger and Freight Equipment Cars." This should be revised as follows: "Rivets shall comply with the A. R. A. specifications for Rivet Steel and Rivets for Steam Boilers and Other Pressure Vessels."

Question having been raised as to whether the use of cold driven rivets was permissible, it is recommended that the following sentence be added to paragraph (b) of section 2 of the Class III and IV specifications. "All rivets shall be driven hot."

2. Tank Heads.—Specifications for Class I and II cars, section 5, paragraph 3 of this section now reads: "Tank cars formerly equipped with head blocks will not be accepted in interchange after January 1, 1926, unless tank heads have been reinforced in accordance with this section." This paragraph is inconsistent with the first and fourth paragraphs of the same section and should be omitted.

3. Dome.—Specifications for Class I and II cars, section 6. Add a new paragraph to paragraph (a) as follows: "When dome cover is renewed it shall be of cast or pressed steel or malleable iron and for screw dome cover, the depth of inside ring shall be not less than 2½ in.; and suitable vents that will be opened automatically by starting the operation of removing the dome cover shall be provided." This contemplates the omission of the note appearing under paragraph (b) for a Class II car.

4. Bottom Outlet Valve.—Specifications for Class I and II cars, section 7-c, and for Class III cars, section 7-d. Add the following to the second paragraph: "Except for cars used exclusively in the transportation of asphalt or soap products and so stenciled, a valve may be attached to the outlet if it is properly capped." Also revise the note appearing in this section of the specifications to read as follows: "In no case shall the extreme projection of bottom outlet equipment extend to within 16 in. above the top of rail, except that for existing cars having fish-belly sills the extreme projection of the bottom outlet equipment may extend to within 12 in. above the top of the rail."

5. Body Bolsters.—Specifications for Class III, IV and V cars, section 11. Add the following paragraph: "For cars built after January 1, 1926, provision shall be made for jacking under the bolsters."

6. Anchorage.—Specifications for Class II cars, section 13, paragraph (a). Add the following paragraph: "As tank cars receive repairs, wooden shims interposed between the longitudinal anchorage and the underframe shall be removed and all-metal anchorage substituted, and when the construction permits the anchorage shall be riveted to the underframe. After January 1, 1928, no cars having wooden shims interposed between the longitudinal anchorage and the underframe will be accepted in interchange."

Specifications for Class III and IV cars, section 13, paragraph (a). Add following paragraph: "For cars built after January 1, 1926, the longitudinal anchorage shall be riveted to the underframe. As cars built prior to January 1, 1926, receive repairs, when the construction permits, the anchorage shall be riveted to the underframe."

7. Safety Valves.—Specifications for Class V cars, section 20. Paragraph (d) now reads: "The design of valve and its arrangement in the dome head shall be submitted for approval." It is recommended that this be modified to read as follows: "The design of valve and its arrangement in the dome head shall be submitted for approval by the Tank Car Committee. Details of approved design will be furnished to interested parties upon application." Add a new paragraph as follows: "Valve must have discharge capacity sufficient to prevent building up of pressure in tank in excess of pressure to which tank is tested."

Repairs to tanks

One of the important users of tank cars invited the attention of the committee to the desirability of establishing certain fundamental standard maintenance practices for tank car repairs coverang particularly the thickness of plates to be applied for patches on tank shells and domes, and the method of application of such patches.

The committee has considered this subject of sufficient importance to warrant an investigation which contemplates a conference with tank car owners, and accordingly has delegated as a sub-committee J. T. St. Clair, A. E. Smith, George McCormick, Thomas Beaghen, Jr., and R. H. Owens.

Safety valves, dome covers and bottom outlet valves

The work in connection with these subjects is covered by reports of the sub-committees.

Investigations and tests designed to promote improvements in these parts for tank cars have now been in progress for several years, and while a number of appliances have been developed and applied for experimental purposes, with more or less satisfactory results, no definite conclusion as to a better and general type of dome cover, safety valve or outlet valve has yet been reached.

In view of the limited progress thus far made, your committee received approval of the General Committee of a joint investigation to be conducted by the A. R. A. Tank Car Committee, the tank car builders through the Association of Freight Car Manufacturers and the American Petroleum Institute. Negotiations with the two organizations mentioned are now in progress, and it is anticipated that a satisfactory arrangement will be reached whereby the three interests mentioned may jointly undertake the development of designs and the conduct of tests through an independent outside agency and thus not only insure an earlier decision as to the most desirable appliances for tank car application but remove the disadvantages and delays incident to the method now in effect. Your committee has delegated as a sub-committee to co-operate with the other parties at interest, your chairman, W. C. Lindner, chairman of sub-committee on Safety Valves and Dome Covers, and W. E. Cooper, chairman, sub-committee on Bottom Discharge Outlets.

It is hoped that at the next annual convention it may be possible to report definite progress in the solution of problems relating to tank car appliances and appurtenances which are so important in the safe transportation of inflammable liquids.

Service tests

Your committee has completed an arrangement whereunder service trials of appurtenances and appliances not covered by the specifications may proceed under authority of the Interstate Commerce Commission pursuant to the regulations for the "Transportation of Explosives and Other Dangerous Articles by Freight." This contemplates a limited number of applications of experimental dome covers, outlet valves and other appliances in order that developments in design and construction may be advanced and the perfection of these appliances thereby effected.

Report of sub-committee on dome covers and safety valves

Since the 1924 report four types of dome covers have been installed for test.

We believe that sufficient service trials of the A. R. A. Fundamental bolted type cover have been made and favorable reports of results obtained warrant the incorporation of the design in the specifications, and that it should be followed in all future applications to cars.

Since the 1924 report a test was made of six safety valves submitted by various manufacturers, as follows:

Identification Number.	Designer or Name.
1	A. R. A. Standard
2	Redcliffe
3	Beasley
4	American Car & Foundry Co.
5	American Car & Foundry Co.
6	American Car (Cooper)

It was the opinion of the committee that while valves No. 2, 3 and 6 did not function properly at the test, this was due to mechanical defects in the construction of the valves and not to the principles of design.

It was also the committee's opinion that the operation of the present A. R. A. standard safety valve could be greatly improved by having the springs checked up to see that they have the ends ground and are square to a center axis.

The test, therefore, developed that the present A. R. A. standard safety valve with a monel metal stem and a spider having a monel metal bushing (as represented in valve No. 5) gave the best results, and it was the consensus of opinion that a service test be made of the A. R. A. Standard valve with these features embodied, in addition to making the seat of monel metal.

By consent of E. A. Smith, J. O. Wilson, R. H. Owens and Thomas Beaghen, Jr., the American Car & Foundry Company, through R. H. Davenport, will, therefore, arrange to manufacture

24 of these valves to be applied to tank cars of the following ownership:

Union Tank Car Company	6 valves.
The Texas Company	6 valves.
Cosden & Company	6 valves.
Mexican Petroleum Corporation	6 valves.

Frequent observations are to be made of these valves in service, and at the expiration of a four-month period they are to be removed from the cars, boxed up without making any repairs or adjustments, and shipped to the Union Tank Car Company's plant at Whiting, Ind., where they will be tested out to ascertain their condition.

The committee is indebted to the Sinclair Refining Company for the use of their plant to conduct these tests, and also wishes to thank the various people and concerns who submitted valves for their co-operation in assisting the committee to carry out this work.

In connection with the 24 valves to be manufactured by the American Car & Foundry Company, and applied to cars of the Union Tank Car Company, the Texas Company, Cosden & Company and the Mexican Petroleum Corp., the committee is awaiting the development of these valves by the A. C. & F. Co. who are experimenting with various metals for the valve seats, and when completed a further test will be made at the American Car & Foundry Company's plant at Milton, Pa., before they are applied to cars for service trial, and in addition a number of other valves submitted by various manufacturers and inventors will be tested to determine if they have sufficient merit to warrant a service trial.

Report of sub-committee on bottom discharge outlets

Your sub-committee on Bottom Discharge Outlets has made a thorough study of all the correspondence and blue prints in its files and submits herewith summary showing the essential facts in regard to each design of valve so far submitted for approval for service trial. The valves indicated by an asterisk are locked on their seats, and from the standpoint of providing security against leakage caused by unseating of the valve by external violence are superior to the valves with which tank cars are now generally equipped.

Inasmuch as at present there are no definite specifications for the complete bottom discharge outlet of tank cars, it is essential that the tank car specifications be amended to definitely authorize the use of valves with which cars are now equipped and to provide for an improved type to be used on all new cars and for replacements on existing cars. Your sub-committee, therefore, submits for consideration the following suggestions:

(1) That Fig. 2 of the present A. R. A. Tank Car Specifications be revised to show a complete assembly of the bottom discharge outlet and its operating mechanism, corresponding to the illustration shown in the I. C. C. Regulations, and including all of the details of dimensions and wording shown on the present Fig. 2:

(2) That Section 7 of the Tank Car Specifications be amended as follows:

7. *Bottom Discharge Outlet.* (a) On tank cars built prior to 1926, if tank is provided with bottom discharge outlet the valve and its operating mechanism must conform in principle to the design in Fig. 2.

(b). Effective January 1, 1926, for new cars and replacements on existing cars, the bottom discharge outlet must conform to the following general requirements designed primarily to prevent accidental unseating of the valve under any condition incident to transportation:

1. A "V" groove must be cut (not cast) in the upper part of the outlet valve casting at a point immediately below the flange, to a depth that will leave the thickness of the casting at the root of the "V" not over ⅜ in. (See Fig. 2).

Exception.—In the case of steam jacketed outlets, groove may be omitted.

2. The flange on the outlet casting must be of a thickness which will prevent distortion of the valve seat or valve by any change in contour of the shell resulting from expansion of lading, or other usual causes, and which will insure that accidental breakage of the outlet casting will occur at or below the "V" groove.

3. The valve must have no wings or stem projecting below the "V" groove in the outlet casting, unless they are scored or designed to break or bend without unseating valve.

4. The valve must preferably be positively held on its seat by some mechanical means (other than a spring) providing sufficient strength to insure that the expansion of freezing liquid in the outlet casting will break off the outlet cap or the outlet casting without unseating the valve; to prevent displacement of the valve on its seat because of the movement of the car, vibration of the tank, or the effect of movement of liquid contents of the tank; and to prevent side lifting of the valve.

5. The valve and seat must be readily accessible or removable for repairs, including grinding.

6. The valve must not tighten on its seat under the vibratory action of the stem or rod.

7. The valve operating mechanism must have means for compensating for variation in the vertical diameter of the tank produced by expansion, weight of the liquid contents, or other usual causes, and should operate from the interior of the tank, but in the event the rod is carried through the dome, leakage must be prevented by packing in stuffing box and cap nut.

It is also preferable that the design of valve operating mechanism be such that the dome cover cannot be applied until the valve is closed.

8. The lower end of the bottom outlet casting must be tightly closed by means of a screw cap or a bolted cover, and to prevent leakage a suitable gasket must be used when necessary.

Before a bottom discharge outlet embodying these features may properly be applied to tank cars which may be used for the transportation of commodities defined as dangerous by the Interstate Commerce Commission regulations for the transportation of explosives and other dangerous articles, the design of the valve and its mechanism must be submitted to the Tank Car Committee for approval.

(c) To provide for the attachment of standard unloading connections—the bottom of the main portion of the outlet valve casting, or some fixed attachment thereto, shall have external "V" threads 5¼ in. in diameter, and a pitch of four threads to the inch. (Fig. 2).

Where a 6-in. bottom outlet valve is used the bottom outlet valve casting shall be designed to have a diameter of 8 in. over threads, and a pitch of four threads to the inch, in addition to connections as above (Fig. 2).

Cars used for the transportation of acids or other corrosive substances, or commodities which are not unloaded through the bottom outlet, if fitted with bottom outlet valve castings to facilitate cleaning of the car, need not have threads as above when designed for the use of a bolted cover.

(d) Same as in present specifications for Class III and IV tank cars as revised at the last meeting of the Tank Car Committee held April 17, 1925, with the words "bolted cover" properly inserted.

The report of the committee on tank cars is signed by A. G. Trumbull (chairman), chief mechanical engineer, Erie Railroad; J. T. St. Clair, engineer of car construction, Atchison, Topeka & Santa Fe; George McCormick, general superintendent motive power, Southern Pacific; W. C. Lindner, chief car inspector, Pennsylvania Railroad System; A. H. Oelkers, chief mechanical engineer, St. Louis-San Francisco; Col. B. W. Dunn, chief inspector, Bureau of Explosives; A. E. Smith, vice-president, Union Tank Car Company; T. H. Beaghen, Jr., Mexican Petroleum Company; R. H. Owens, master car builder, Mid-Continent Petroleum Company.

Discussion

It was stated that the committee expects to take up repairs to tank cars next year. Referring to tanks equipped with the head block anchorage, H. L. Shipman (A. T. & S. F.) mentioned the fact that there is no limit now set as to when a shoe patch should be applied to a tank head. It was suggested that the bottom of the head be reinforced by a shoe patch when it is caved in so that the surface of the tank is ½ in. below the original contour of the sheet. If a tank is deformed more than that, it is getting near the breaking strain at the flange and is liable to crack under a shifting load while being switched.

On motion the report was accepted and the recommendations of the committee ordered referred to letter ballot.

Report on brakes and brake equipment

In last year's report your committee gave some consideration to the question of brake beam safety supports, and have in the interim inspected a large number of cars equipped with such devices. This inspection developed the fact that a large variety of supports are being applied, but with few exceptions they require constant maintenance to maintain them in condition to serve the purpose for which they were applied. Those types which appear most dependable and free from necessity for frequent repair, in most cases, present some difficulty to the application and removal of brake beams without dismantling the truck. Your committee has not up to the present time developed anything satisfactory along the lines of an efficient brake beam safety support, but are continuing their efforts.

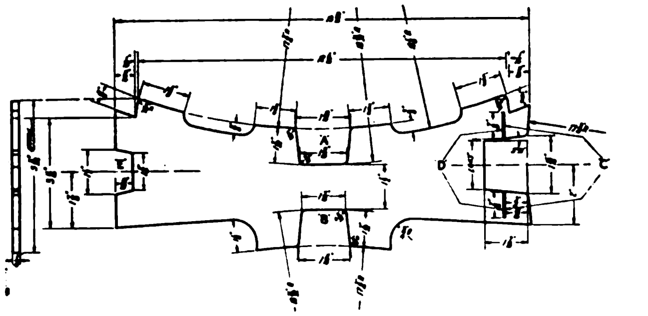
We have been requested to specify a price for brake cylinder packing other than the price now specified in Interchange Rule 101 on the basis that material of a superior quality is now available. We feel that the present price for the common brands of leather and composition packings now on the market is ample, in view of the fact that they may be procured at prices specified. We are arranging for an investigation of brake cylinder packings to determine if there is any justification for changes in Rule 101.

During 1920 your committee conducted some tests to determine if possible a standard capacity of retaining valve for freight equipment cars. Owing to the business depression following this work was not concluded. The committee has been

instructed to resume investigation of this subject and have made some preliminary tests.

During the past year your committee has completed the revision of Rules and Regulations for Testing, Inspection and Maintenance of Power Brakes. In this connection we would call attention to rule 15 (a) and (b) in the Passenger Code of Interchange Rules. This rule should be modified as follows:

Rule 15 (a) Brakes must be in perfect working order. Brake cylinders, slack adjusters, triple valves, control valves and high speed reducing valves must have been cleaned, oiled and tested within twelve months, and date



Brake shoe gage

of last cleaning and oiling stenciled with white paint in a suitable location for visual inspection. Dirt collectors and strainers must be cleaned at time of cleaning triple valves or control valves.

(b) Piston travel less than 7 in. or more than 9 in. with maximum service brake application, must be adjusted to nominally 8 in.

Classification of Rebuilt Brake Beams in order that second hand beams might be classed and charged for at the same price of new beams has been considered, however, you will appreciate that repaired beams are placed in exactly the same service as new beams, and may be expected to become subject to necessity for further repair in much less time than the latter; and the charges and credits for repaired beams we think, are ample to reimburse the railroads for such repairs. We are under the impression it would be a mistake to establish for repaired beams the same status as applies to new beams.

Brakes and brake equipment

In connection with brake beam safety supports your committee has considered brake beam troubles due to failure of hangers. The present A. R. A. brake head provides for a 1-in. brake hanger, and recently the drawings were modified to eliminate the sharp edges in the hanger groove to prevent wearing hangers, causing them to break in the corners. The committee will co-operate through a sub-committee with the Arbitration Committee who now have this subject under consideration, with a view of providing details for brake beam and brake hanger maintenance.

Suggestions for changes in graduating springs for freight triple valves has been made and we wish to advise that this matter is now in the hands of the Director of Research A. R. A. who contemplates tests of such devices. Suitable action will be taken in accordance with the information disclosed by such tests.

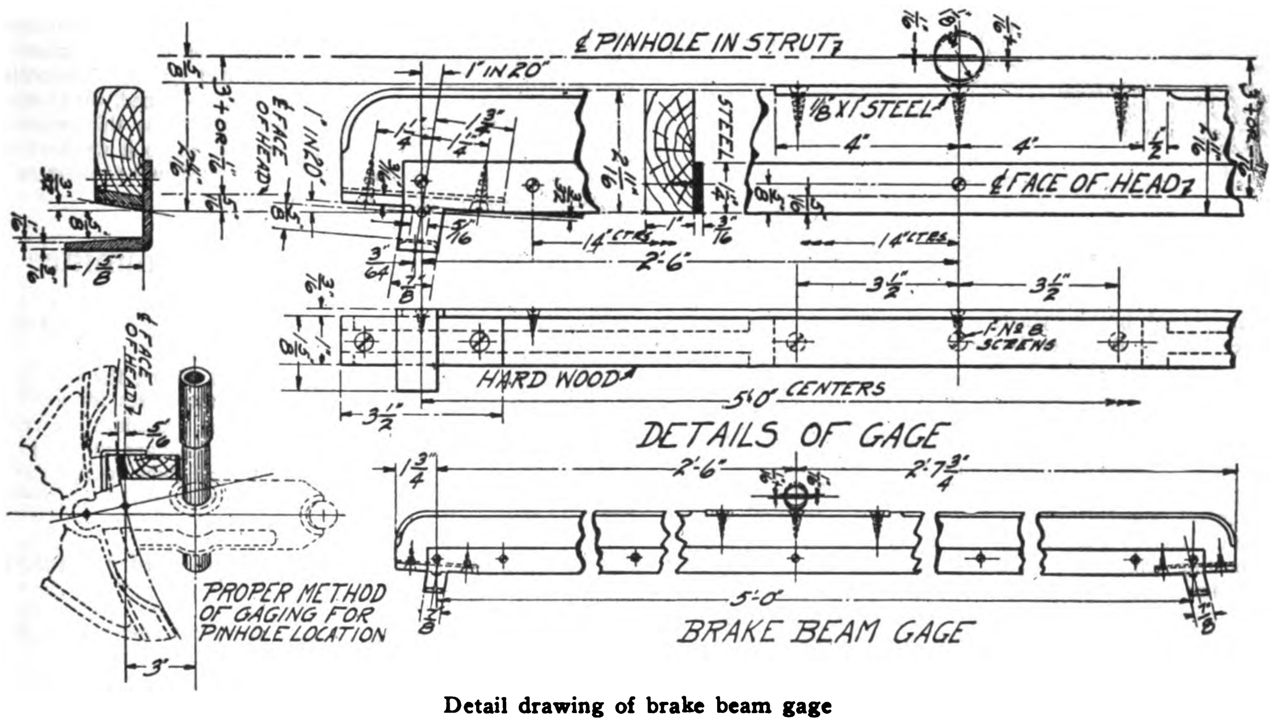
Recommendations

The 1921 report of the committee on Brake Shoe and Brake Beam Equipment contained a drawing of the A. R. A. brake beam gage, which showed several changes over the gage adopted in 1920 and which is still the A. R. A. standard. The present standard adapted itself to beams made to hang 14 11/16-in. on a 33-in. wheel when the strut was parallel to top of rail, however, the position of the present standard A. R. A. brake beam is 13 in. from center of brake head to top of rail and it will be necessary to change the dimension 2 15/32 in. from front to back of gage to 2 11/16 in., and provide a taper of 3/32 in. to that part of the gage which comes in contact with the face of the upper head lug. These changes were outlined in the 1921 report. We would, therefore, at this time recommend the changes in brake beam gage drawing shown in the A. R. A. Manual, division (B), page 7, to conform to that shown in the accompanying drawing.

We would also recommend changing the present A. R. A. brake head gage drawing shown on page 8, A. R. A. Manual, division (B), to conform to that shown below, as this gage is universally used by brake beam manufacturers because it has the advantage of more accurately gaging the entire face of the brake head, and there are no changes of dimensions which will affect the present A. R. A. standard.

An apparent weakness in the present A. R. A. brake shoe gage has been brought to our attention and we would recommend a change in the present drawing shown on page 9, A. R. A. Manual, division (B), in order to increase the dimension ¾ in. to 1½ in. and strengthen the gage at the center as shown in the drawing.

Attention has been directed to the practice of stretching springs in the spring type retaining valve, presumably for the purpose of overcoming leakage of valve seats. This trouble was more prolific when the spring type retainer first came into general use than is the case at the present time. The committee

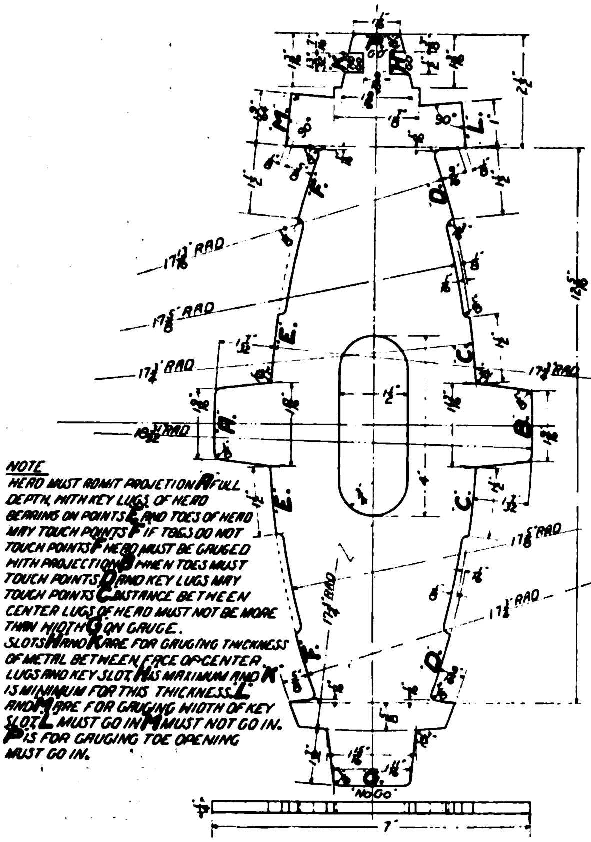


Detail drawing of brake beam gage

recommends that each road call attention of their repair men to the practice of stretching these springs and request that such practice be discontinued. Stretching the springs increases the brake cylinder pressure retained, reduces the flexibility of control and may contribute to wheel and brake shoes troubles.

Your committee recommends for letter ballot the following:

The committee's attention has been called to cases where there is an appreciable difference in the actual and nominal diameter of brake cylinders which influences the life and efficiency of brake cylinder packing on account of cylinders being considerably larger than the nominal diameter. Your committee would, therefore, recommend for adoption as recommended practice, that the



Brake head gage

actual diameter of brake cylinders for freight cars should not exceed the nominal diameter by more than 1/16 inch.

Advancing to standard the present recommended practice brake beam having central head hanging only.

This report is signed by G. H. Wood (chairman), supervisor of air brakes, Atchison, Topeka & Santa Fe; T. L. Burton, air brake engineer, New York Central; B. P. Flory, superintendent motive power, New York, Ontario & Western; J. M. Henry, general superintendent motive power, eastern region, Pennsylvania System; W. H. Clegg, chief inspector air brakes and car heating equipment, Canadian National Railways; Mark Purcell, general air brake inspector, Northern Pacific; R. B. Rasbridge, superintendent car department, Reading Company; G. E. Terwilliger, supervisor of auxiliary equipment, New York, New Haven & Hartford.

Discussion

In obtaining data for this report, it was stated that the committee inspected a large number of cars equipped with different types of brake beam safety supports and found them in all stages of disrepair. The support would be missing entirely on one truck or on one side of one truck; in some cases they were missing on both trucks. The opinion was expressed that supports riveted rigidly to the truck frame cannot be depended on and that they require too frequent maintenance to be kept in condition and the inspectors are not giving them sufficient attention.

It seemed to be the consensus of opinion that something should be done to improve the general air brake cylinder packing situation. While there are packings on the market which give much better performance than the packing provided for at the price given in the rules, the point was made that the average railroad cannot be justified in putting the higher price packing into foreign cars and getting other packing back in its own cars. It was stated that the New York Central has been operating a number of types of packings out of New York City and Chicago for practically four years. These packings are inspected periodically with a gage to determine leakage and as a result of these tests this road has been materially relieved of troubles from brake cylinder leakage.

One speaker in commenting as to the relative merits of the Wabco packing leather as compared with the leather which was formerly used for the retaining ring stated that his road had purchased a great many more of the Wabco cups for renewal than it had in previous years. However, an investigation showed that a large number of the Wabco cups had been scrapped when they were in perfectly good condition.

Attention was called to the fact that considerable difficulty is apt to be incurred in the application of the composition cup. The cup is not compressible like the other cup and unless the men handling it are cautioned, they are likely to put on the follower and tighten the nuts the same as before, with the result that the man testing out the brake gets a blow past the sleeve. He thinks it is a leaky cup and takes it off.

The opinion was expressed that rust is one of the important sources of packing cup wear. There is no question about the fact that rubber has abrasive qualities that are not present in leather. When the Wabco cup was first brought out, it seemed to be the consensus of opinion that anything in the way of grease or oil could be used to lubricate the cylinder. It was found by actual test that it was necessary to have a high grade cylinder lubricant, otherwise the cylinders would rust and cut out the cups.

The committee is seeking information as to the experience on different roads with various types of composition packing in order that it can make such recommendations as will enable the railroad to put a freight car in service and run it from one cleaning period to the other.

In discussing the subject of stencilling uncleaned triple valves, Chairman Tatum remarked that during the past year he had had brought to his attention triple valves on cars stencilled as clean, but on which the triple valves had not been cleaned. There were also instances where he had seen the dirt collectors stencilled as having been cleaned when they were not cleaned. He suggested that a rule should be framed which will cause this work to be done right or that will make it expensive to do it wrong.

The report of the committee was accepted and recommendations made therein referred to letter ballot.

Report of arbitration committee

During the year Cases 1,333 and 1,383, inclusive, have been decided and copies sent to the members. A vote of concurrence in the decisions is requested by the committee.

Considerable variance has been noticed during the past year as to the course of the procedure in submitting cases for arbitration. The fundamental principles governing this procedure are re-stated in the report. All recommendations for changes in the rules of interchange submitted by members, railroad clubs, private car owners, etc., have been considered and, where approved, changes have been recommended.

Recommended changes in the rules of interchange

RULE 2

The committee recommends that the second paragraph of Section (b) be modified as follows:

For inside door protectors, *side or end*, the car transfer check, etc.

RULE 3

The committee makes the following recommendations; that the effective date of the second paragraph of Section (b) be extended to January 1, 1927; that the effective date of the second paragraph of Section (d) be extended to January 1, 1928; that the effective date of the next to last paragraph of Section (e) be extended to January 1, 1927.

The committee recommends that the effective date of Section (i) be extended to January 1, 1927, and that the section be modified as follows:

Cars built new on or after January 1, 1927, will not be accepted

from owner unless equipped with steel underframe having a minimum cross sectional area of 24 square inches between the draft back stops.

Cars built prior to January 1, 1927, will not be accepted from owner on or after January 1, 1928, unless equipped either with steel underframe, wood or metal draft arms extending beyond the body bolster, or metal draft arms extending to metal body bolster and securely riveted to same.

The committee recommends that the effective date of the second sentence of Section (1) be extended to January 1, 1927.

Rule 4

The committee recommends that the second paragraph of this rule be changed as follows:

Defect cards shall not be required for any slight damage (new or old), that of itself does not require repairs before reloading of car, except that the car may be used, under load, in movement to shop for the required repairs.

The recommended modification is a reasonable exception to the general rule which contemplates that cars with defects requiring repairs shall not be continued in service indefinitely. The general restriction against reloading defective cars is advisable as a measure against the issuance of defect cards for unnecessary repairs.

With reference to the second sentence of the present rule, the experience has been that in many cases it is practically impossible to determine whether the defects were new or old.

Rule 9

The committee recommends that make or name should be omitted from the information to be specified on billing repair cards after item of brake beams, R & R.

Rule 17

The committee recommends that Section (e) of this rule be modified as follows:

A. R. A. No. 2 or A. R. A. No. 2 plus brake beams may be used in repairs to all freight equipment cars equipped with non-A. R. A., A. R. A. No. 1, or A. R. A. No. 2 brake beams; charges and credits to be on basis of beams applied and removed. A. R. A. No. 2 plus and A. R. A. No. 3 brake beams must be replaced in kind.

Rule 30

The committee recommends that Section (g) of this rule be modified as follows:

When a car is reweighed and remarked the car owner must be promptly notified of the old and the new weights, with place and date. The proper officer to whom these reports should be made will be designated in The Official Railway Equipment Register.

Rule 32

The committee recommends the addition of a new second paragraph to this rule to read as follows:

Steel tank heads (on tank cars), burst, except when due to inferior material, material less than required thickness, omission of reinforcing shoes where required, burned in flanging, welds or other improper workmanship; in any of such cases handling line must furnish car owner with statement showing actual condition of tank head which caused the failure.

The committee recommends that Item 4 of Section (d) of this rule be changed as follows:

No rider protection when necessary, if car is damaged to the extent shown in Rule 44. The same responsibility applies also, if car is damaged to the same extent (per Rule 44), due to defective, ineffective or inoperative hand-brake rigging, while handling car with rider protection, even though such faulty conditions may have developed during the switching operation.

The elimination of Item 4 from Section (d), and the substitution of combination factors on certain classes of tank cars to constitute handling line responsibility, as proposed by the American Petroleum Institute, is not concurred in.

The claim for this additional protection is based on the premise that tank cars comply with the tank car specifications of the American Railway Association, in some instances exceeding them, and that therefore, any damage to the sills must of necessity be the result of improper handling.

The fact that tank cars when built meet the A. R. A. tank car specifications does not of itself guarantee against subsequent failures of sills, etc., in fair service, resulting from deterioration or accumulation of strain and fatigue. Failure of buffer castings is of frequent occurrence in fair service, resulting largely from defective or inadequately maintained draft gears and coupler back stops. In this same connection, the coupler is also subject to failure although conforming to the Specifications.

The committee recognizes that under the present Rule 32 owners are obliged to assume responsibility for extensive damage to cars, some of which may have been due to improper handling, particularly by excessive impact, and, therefore, with the view of placing upon handling lines a greater measure of responsibility for the careful handling of equipment and, further, to encourage a higher standard of hand brake maintenance, the above changes are justifiable.

The committee recommends that Item 5 of Section (d) of this rule be modified as follows:

Coupling on with locomotive when first car is damaged, including damage to adjoining cars (in consecutive order) in same draft.

The committee recommends the elimination of the last paragraph of this rule as it has been covered by the second paragraph of Rule 4.

Rule 33

The committee recommends that the first paragraph of this rule be modified as follows:

Owners will be responsible for the expense of repairs to safety appliances where not involved with other delivering line damage, except on tank cars when sideswiped or cornered.

Rule 43

The committee recommends that the note under this rule be eliminated as it is covered in the new Rule 44.

The committee also recommends that the Interpretation No. 2 of this rule be eliminated on account of the new second paragraph of Rule 32.

New Rule 44

The committee recommends a new rule, to read as follows:

When a car is damaged to the extent shown below, if it occurred in ordinary handling, a statement must be furnished showing the circumstances under which the damage occurred in order to establish the responsibility of the car owner for the repairs. This statement, in the case of cars reported under Rule 120, to accompany request for disposition of car, and, in cases where it is not necessary to report the car under Rule 120, to accompany the bill for repairs.

(1) Six or more longitudinal sills on wooden underframe cars; however, if not more than three sills are broken new, the renewal or splicing of the remainder being necessary account of decay, elongated bolt holes or other old defects, a statement as to the existence of such old defects will be sufficient evidence of the responsibility of car owner for all repairs, providing after a thorough investigation it was not found that car was subjected to unfair handling as provided by Rule 32.

(2) Five or more longitudinal sills on composite wooden and steel underframe cars.

(3) Four or more steel longitudinal sills on steel or steel underframe cars.

(4) All longitudinal sills on all-steel underframe cars having but one steel center member.

(5) Two steel center members on tank cars having two steel longitudinal sills only.

(6) Steel tanks of tank cars shifted where secured by bolster or center anchorage.

(7) Saddle sheared from tank, or tank sheet buckled between saddle castings, or damage to both draft members on same end of car, on tank cars without center sills.

Note: Draft members, wood or steel, extending from end sill to end sill and used to reinforce center sills, are not longitudinal sills.

Reason: In view of the recognized weakness of many of the wooden underframe cars due to decay or other old defects in the sills, which are unquestionably owners' defects, and the impossibility of determining the actual circumstances under which the final failure occurs in such cases, the handling line is entitled to a greater measure of protection than is afforded under the present rule. The insertion of the note with reference to continuous draft members is considered necessary for a uniform understanding.

Rule 60

In order to prohibit the cleaning of air brakes until after the expiration of eleven months, unless car is shopped for other repairs or the air brakes are defective, the committee recommends that the second paragraph of this rule be changed as follows:

After the expiration of nine months, if car is on repair track for other repairs, the air brakes may be cleaned at same time. After the expiration of eleven months, the air brakes may be cleaned irrespective of whether car requires other repairs.

RULE 76

The committee recommends that this rule be changed as follows:

Tread worn hollow—cast iron and cast steel wheels: if the tread is worn so that projection on under side of gage does not come in contact with tread of wheel. (See Fig. 4-D), or rim liable to breakage.

Tread worn hollow—wrought steel wheels: if height of flange is 1½ inches or over, as measured with standard steel wheel gage or approved equivalent.

Note: The drawing of the standard wheel gage will be shown in the 1925 report of the Committee on Wheels.

RULE 86

The committee recommends that the wheel seat dimension for the 70,000-lb. capacity axle, shown in the table under Section (a) of this rule, be changed from 5⅝ in. to 5¾ in., as recommended by the Committee on Car Construction.

The committee recommends that standard Class "F" axles be added to the table under this rule as follows:

A Total weight on rail	B Nominal capacity	Limits of Wear					Dimensions, New						
		C	D	E	F	H	C	D	E	F	G		H
Lb.	Lb.	In.	In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	In.
251,000	200,000	6	7⅞	6¾	12½	¼	6½	8⅛	6⅞	12	7	8¾	⅞

The committee recommends that the second, third and fourth paragraphs of Section (b) of this rule be changed as follows:

A. R. A. Standard axle shall be used to replace non-A. R. A. Standard axles of like capacity when over-all length conforms to A. R. A. Standard, and shall also be used to replace A. R. A. Standard 60,000 lb. capacity axles having wheel seat less than condemning limit for such axle, at expense of car owner, except that in case of delivering line defects the charge against owner shall be confined to the difference in value between the non-A. R. A. Standard axle or A. R. A. Standard axle removed and the A. R. A. Standard axle applied.

Non-A. R. A. Standard axles may be used to replace non-A. R. A. Standard axles in kind, until January 1, 1928, only in such cases where A. R. A. Standard axles are not a proper substitute.

The fourth paragraph is eliminated.

RULE 91

The committee recommends that the last sentence of Section (c) of this rule be omitted, a new paragraph be added as Section (d), and that present Sections (d) and (e) become new Sections (e) and (f) respectively, as follows:

(d) If objections to bill, as per Sections (b) and (c), do not amount to $1.00 in aggregate no exception shall be taken, but bill shall be passed for payment as rendered. In any case, however, if entire bill is improperly rendered, it may be returned regardless of its amount.

RULE 98

To simplify billing transactions, the committee recommends the addition of a new paragraph to Section (g) of this rule, as follows:

The amount of service metal on both wheels will be governed by the minimum amount on either wheel, except when a defective wheel is necessarily scrapped before it reaches the limit of wear, in which case the service metal on mate wheel will be credited on basis of the actual amount.

RULE 101

The committee recommends that Items 127 and 128 of this rule be eliminated and that Items 132 and 133 be modified as follows:

Item 132: Coupler body, A. R. A., one, new, or second-hand, steel, 5 in. by 7 in. shank .... charge $9.41, credit $1.10.

Item 133: Coupler body, A. R. A., temporary standard, one new or second-hand, steel, 5 in. by 7 in. shank .... charge $10.35, credit $1.23.

RULE 104

The committee recommends that first two paragraphs of this rule be modified as follows:

Second-hand A. R. A. couplers or parts shall be charged and credited at 75 per cent of value new, except that new or second-hand coupler body, steel, 5 in. by 7 in. shank, former standard or temporary standard, shall be charged and credited at prices specified in Items 132 and 133 of Rule 101. Credits shall be confined to the body, lock, knuckle and knuckle pin, whether second-hand or scrap. In the Type D coupler, credit shall be allowed for all parts.

When new A. R. A. coupler is applied it shall be so charged whether or not it is of same make as that removed, except that where new coupler body, steel, 5 in. by 7 in. shank, former A. R. A. standard or temporary standard, is applied it shall be charged at value shown in Items 132 and 133 of Rule 101.

Passenger car rules of interchange

RULE 2

The committee recommends that the first paragraph of this rule be modified as follows:

Cars, loaded or empty, offered in interchange with defects for which owner is responsible, provided they are equipped with air brake, air signal and steam heat train line having end steam valves and otherwise meet the requirements of the receiving line as to safety and clearances, must be accepted, with the following exceptions:

RULE 7

The committee recommends that Item 4 of Section (f) of this rule be revised to conform to the recommended revision of freight car Rule 76.

RULE 8

The committee recommends that Section (c) of this rule be modified as follows:

Cast-iron wheels in place of cast-steel, wrought-steel or steel-tired wheels; cast-steel wheels in place of wrought-steel or steel-tired wheels; steel-tired wheels in place of wrought-steel wheels.

The members of the committee are T. W. Demarest (chairman), Penna.; F. W. Brazier, N. Y. C.; J. Coleman, Canadian National; W. H. Fetner, M. P.; J. J. Hennessey, C. M. & St. P.; J. E. O'Brien, Seaboard Air Line; H. L. Shipman, A. T. & S. F., and G. F. Laughlin, Armour Car Lines.

Discussion

The discussion of this report was very brief as it dealt only with the withdrawal of two recommendations made by the committee. It was decided to withdraw the recommendation for the change in Rule 17 and with reference to Rule 32, Item 4, Section (d), the committee decided to cross out the word "ineffective" because of the possibility that the word may be misconstrued.

The report was accepted as presented.

Prices for labor and materials

The committee submitted the following report under A. R. A. Interchange Rules 101, 107, 111 and 112 and the freight car code Rule 22.

Prices for materials—Rule 101

New prices are provided for reinforced doors on automobile and refrigerator cars. Items 125 and 128 are eliminated and items 132 and 133 changed at the suggestion of the Arbitration Committee.

To discourage the practice of cars being held out of service awaiting receipt of friction gears from the owners, and to facilitate the preparation and checking of bills, the committee has recommended a proposed addition to Rule 101. The new prices proposed are to be charged for various friction draft gears applied new complete, when necessary to apply complete gear on account of any or all parts of old gear becoming defective. In conformity with Rule 88, one type of gear may be substituted for another if the type substituted conforms to the one removed as to sill spacing and coupler pocket limits. In such substitution complete gears removed shall be credited at 25 per cent of the price new, complete, when removed on account of defective friction casing or castings, and at 50 per cent of the price new, complete, when removed on account of any other part or parts of the gear being defective.

Second-hand complete friction draft gears shall be charged at 75 per cent of the price new, complete.

When new or second-hand parts of any type of friction draft gear are applied in replacement of such parts becoming defective, they should be charged at the factory prices, as new, plus 15 per cent.

New Item: 16-a—Arch bar, on trucks without column bolts and

with channels riveted to arch bars, one or all on same side, R & R or R, charge on bolt and rivet basis. Add jacking of car when necessary.

New Item: 19-a—Cylinder body, combined type (body only), charge for 8-in. $5.47, and for 10-in. $6.60.

New Item: 19-b—Cylinder, complete, detachable type (without push rod), Nos. 69817-69751, charge for 8-in. $12.32 and for 10-in. $16.80.

New Item: 19-c—Cylinder complete, combined type (without push rod), Nos. 69816-69818, charge for 8-in. $11.07 and for 10-in. $15.55.

New Item: 108-a—Brake connection, bottom, forged, hollow design, price of each $2.40; credit $0.12.

New Item: 142-a—Coupler cross key lock, U type, price for each unit $.055; credit $.005.

New Item: 156-a—Half door or twin door, reinforced type, for the side of an automobile car, price for each applied $19.00. No credit for scrap.

New Item: 156-b—Half door or twin door, right hand with fixtures, for the side of refrigerator cars, wooden, price of each applied $24.45. No credit for scrap.

New Item: 156-c—Half or twin door, left hand, for the left side of refrigerator cars, wooden, price of each applied $17.38. No credit for scrap.

Prices of labor—Rule 107 and 111

Investigations reveal that no change is warranted at this time in existing labor allowances per hour as set forth in Items 427, 442 and 443.

The report recommends several changes in the wording of items in Rule 107 to define more clearly what is included in the time allowances, some of which are changed, and the following new items are added:

New Item: 121-a—Coupler cross key lock, U type, R & R or R, when coupler cross key is not R & R or R. Ordinary refrigerator cars—3 hr.

New Item: 317-a—One end sill, flush type, on open top cars, renewed, includes R & R or R of end stakes outside of car. (No extra charge for coupler R & R or R at the same time.) Ordinary car—9 hr.

New Item: 319-a—One end sill, flush type, on open top cars, renewed when one or more defective sills are renewed or spliced, includes R & R of end stakes outside of car. Ordinary car—7 hr.

Destroyed or damaged cars—Rule 112

The committee recommends a complete revision of Rule 112 in line with the slight reductions occurring in the market prices.

The following addition has been proposed to be added to this rule: A refrigerator car is either an RA, RB, RM or RS car as defined in Section L of the A. R. A. Manual. All VS, VA, Eastman Heater and other special types of house cars should be settled for on a box car basis.

It is proposed to change, in Interchange Rule 22, the price of Pintsch gas per receiver set from $1.54 to $1.60.

The report is signed by A. C. Calkins (chairman), N. Y. C.; Ira Everett, Lehigh Valley; J. K. Watson, A. T. & S. F.; T. J. Boring, Penn.; H. H. Harvey, C. B. & Q.; H. H Boyd, Canadian Pacific; A. E. Smith, Union Tank Car Company, and M. R. Esherwood, Swift & Company.

Discussion

After the reading of the report Mr. Calkins stated that Items 179 and 187 contained allowance for refrigerator cars which should come out.

The report was adopted as presented by the committee.

Report on couplers and draft gears

In order that the subject of draft gears might be exhaustively studied, the committee recommended, under date of December 6, 1924, that the sum of $50,000 be appropriated to cover the cost of designing, building and housing a 27,000 lb. drop test machine together with the necessary recording apparatus.

This recommendation was unanimously approved by the General Committee, and the Board of Directors on March 20, 1925, authorized an appropriation of $50,000 for constructing a drop test machine as recommended. The necessary steps are being taken in arranging for the detail plans and building of this machine, determining upon the most suitable location for its installation, and erecting it, all of which under the direction of the Mechanical Division and with the supervision of the president of the Association will be brought to as speedy a conclusion as possible.

The information that will be developed by this testing machine will be of the greatest value to the railroads as strictly comparable data on the performance of draft gears of different designs, both new and after periods of wear in actual service, will be available.

From the information to be obtained, suitable specifications are to be prepared for the purpose of eventually restricting the use of draft gears to those that are known to meet the prescribed standards of efficiency and through the experiments to be conducted obtain such facts and information as will assist in the development of draft gears generally.

Couplers other than A. R. A. standard

The present specifications for purchase and acceptance of A. R. A. Standard "D" couplers, knuckles, locks and other parts make no reference to couplers of former types which are being ordered for repairs and will be required until the disappearance of cars of design not suitable for the Standard "D" coupler.

It is felt that the static and dynamic tests formerly required for M. C. B. couplers should be dispensed with and that for such types the tests need cover the quality of the material only.

To meet this situation the note now appearing under the title of the present specifications for Standard "D" couplers should be revised to read as follows:

"These specifications replace specifications for M. C. B. automatic couplers adopted in 1899. When couplers other than type 'D' are ordered under these specifications, they shall conform to the requirements for quality of steel, workmanship, and details of inspection. No tests of the couplers as a whole will be required."

It is recommended that the reissuance of this note be referred to letter ballot.

Failure of cotters securing draft gears

Attention is directed to the frequent failure of the various forms of cotters in general use for securing cross draft keys in place. These cotters are failing both on account of being worn away due to contact with the draft castings. and from being sheared off due to lateral movement of the coupler and draft key when curving.

The washers encircling the cross draft key used by some roads greatly improve the conditions resulting from wear but are of no benefit as concerns shear.

An investigation conducted by your committee shows that while the failure of these cotters is most frequent in the front cross draft key it occurs to a considerable extent in all keys. Cases have been observed of U-shaped cotters made of ⅝ in. steel being sheared off on new cars when being moved over curves.

It is proposed to cover this matter in a circular to the members as soon as it has been determined which of certain methods under consideration for correcting the trouble are most satisfactory.

Standard "D" couplers—Minor changes

In order to determine how the Standard "D" couplers and parts are standing up in service and whether any changes in the detail design should be made, the roads represented on your committee have arranged for special examination and report on each Standard "D" coupler or part requiring renewal during a period of six months.

These reports will be consolidated to show just what is taking place and should indicate clearly whether the present coupler is equal to the service conditions encountered, and whether any modifications in design should be made. The results of this investigation will be included in our report to next year's Convention.

Your committee has authorized a few changes of a minor nature in the detail designs of the standard "D" coupler and gages, none of them in any way affecting interchangeability or strength of the parts, and all of them being agreed to by your committee and the mechanical committee of the coupler manufacturers and the standard drawings on file corrected accordingly.

The report was signed by R. L. Kleine (chairman), assistant

chief of motive power, Penna.; J. R. Onderdonk, engineer of tests, B. & O.; C. J. Scudder, superintendent motive power and equipment, D. L. & W.; J. A. Pilcher, mechanical engineer, N. & W.; C. B. Young, general mechanical engineer, C. B. & Q.; Samuel Lynn, master car builder, P. & L. E.; L. P. Michael, mechanical engineer, C. & N. W.; E. A. Gilbert, general master car repairer, S. P.; and Prof. L. E. Endsley, University of Pittsburgh.

Discussion

It was pointed out during the discussion that definite plans were under way for the installation, at some accessible university, of a draft gear drop test machine. The appropriation of $50,000 for this machine was mentioned in the General Committee's report.

It is considered a waste of time to make drop tests at the manufacturers' plants on couplers of the standard design. The drop and jerk tests were design tests to protect the railroads when buying couplers of an unknown quantity. However, the railroads should be assured that the steel used in the couplers is of a proper quality.

The report was accepted and referred to letter ballot.

Report of loading rules committee

During the past year the committee has been in conference with the automobile shippers and the steel industries on the subject of Loading Rules as applied to their products. These shippers, as well as others, have placed before the committee a number of recommendations for changes and additions to the Rules. Trial shipments involving new methods of loading small diameter tanks, concrete pipe and wide plates not adequately covered by the Rules were followed through to destination in order to determine whether they were practical and safe.

As a result of its investigations the committee submits the following changes and additions to the Rules for approval and submission to letter ballot for adoption as standard of the Association.

Changes in general rules for the loading of materials on open top cars

Rule 13, First Paragraph—The width of overhanging loads placed on single cars, *when flat cars are used as idlers,*

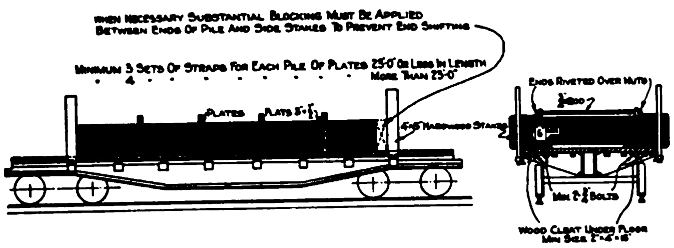


Fig. 44E—Manner of securing wide plates loaded on flat cars

must never exceed the following dimensions as a maximum and the load must be governed by the total length of lading and weight limits prescribed in table under Rule 23 for the length of car used. *When gondola cars are used as idlers see limitations prescribed in Rule* 221.

Rule 28—Bearing-pieces must never be placed between bolster and end of car, unless special provision (*See Rule* 217) is made therefor in detail instructions. (The remainder of the paragraph is unchanged).

Changes in rules governing the loading of lumber, logs, ties, etc.

Rule 100—The following is added to Section B:

Height of load given is measured either from floor line of flat cars or from top of sides of gondola cars.

Section C. For loads of lumber or timber, not of equal thickness which cannot be lapped or stripped, the sizes of hardwood stakes must not be less than 4 *in. by* 4 *in.*

EXPLANATION: Sections B and C are revised to conform with the second paragraph of Rule 102.

Changes in rules governing the loading of structural material, plates, etc.

Proposed New Rule 201-A—When plates are too wide to be loaded in accordance with Rule 201 they may be loaded in accordance with Fig. 44-E. When so loaded there must be at least three tie straps, each not less than ½ in. by 3 in, to each pile of plates 23 ft. or less in length and four tie straps, each not less than ½ in. by 3 in. for each pile of plates over 23 ft. in length.

Each tie strap must be secured by not less than two ¾-in. bolts spaced at least 6 in. apart and passing through floor of car with cleats under floor 2 in. by 4 in. by 18 in. The material

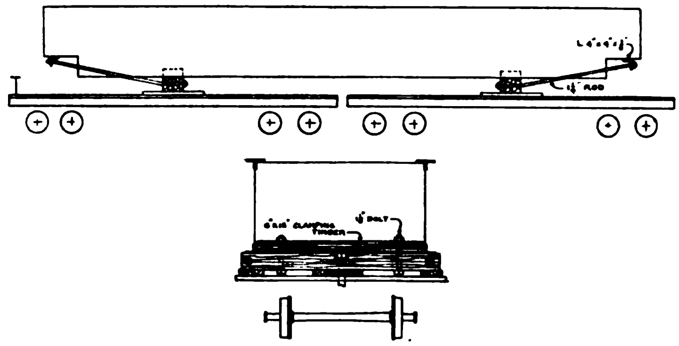


Fig. 76A—Loading of turntables

must be placed against stakes not less than 4 in. by 5 in. at one end of the car and at the opposite end two stakes not less than 4 in. by 5 in. must be placed in the nearest stake pockets to the end of the load. If there is any space between the end of the load and stakes, this space must be built up as per Fig. 44-E to prevent end shifting. Care must be taken to have the straps fit the load snugly and the tops of the clamps must be tied together by ¾-in. rods with ends riveted over nuts.

EXPLANATION: Numerous shipments have shown this method clamping to be satisfactory and it takes care of wider plates than now provided for in the rules.

Rule 203—Gondola cars loaded with plates or other material on floor of car may have plates that are too wide for the car loaded on top of car sides when height of sides does not exceed 3 ft. (See Fig. 45 or 45-A). Such superimposed plates must be supported by posts 4 in. by 6 in., one set of posts for each 6 ft. length of lading, with a minimum of three sets of posts for each tier of plates. Side motion to be prevented by not

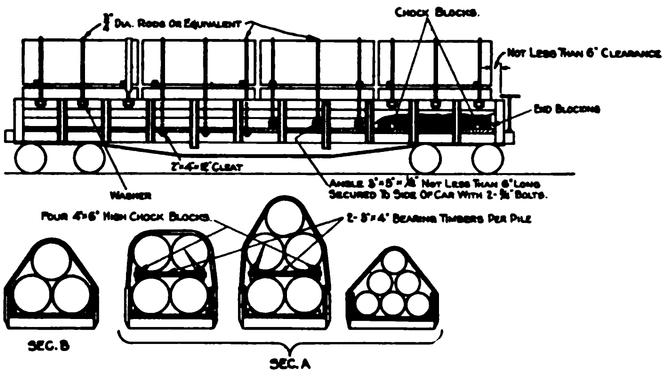


Fig. 101A—Manner of loading small diameter tanks on flat and gondola cars

less than three clamps constructed as shown in Figs. 45 or 45-A. Longitudinal motion to be prevented by *uprights*, 4 *in. by* 6 *in. bolted to side of car with ⅞-in. bolts and backed up by struts* 2 *in. by* 8 *in. spiked or bolted to sides of car.* Total weight of plates loaded in this manner must not exceed 75 per cent of the Load Weight, as per General Rule 5.

EXPLANATION: Rule revised to prevent end shifting of the plates. It was found by experience that the diagonal struts split readily when placed directly against the plates.

Rule 211—When one or both bearing-pieces are placed on the car floor they must be located over the car body-bolster or between car body-bolsters, and must never be placed between car body-bolster and end of car unless special provision (*See Rule* 217) is made therefor in detail instructions. When one or both bearing-pieces are placed on top of car sides they may be located within 12 in. either side of the center line of the freight car body-bolsters.

Rule 222—The idler used with loads as shown in Figs. 54 *and* 55 may be a low side gondola car, but must have at least 4 in. clearance vertically between load and idler body or brake shaft.

Rule 247—The bolsters may be held to the turntable in the manner shown in *Fig.* 76, or if rivet holes are available in the lower flanges, they may be held with four ¾-in. bolts at each end.

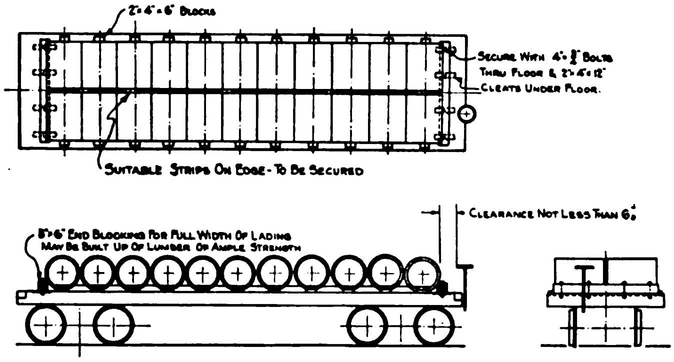


Fig. 109A—Manner of loading concrete culvert pipe on flat cars

Another method of securing the bolsters to the turntable by clamping to the inside flanges is shown on Fig. 76-A. When turntables of the straight girder type are loaded in this manner, rods to prevent end shifting must be applied as shown in the figure. The bolsters must be secured to the *car* by a center pin 2½ in. in diameter, passing through bolster, center-plates and top timber of cribbing *or floor of car.*

EXPLANATION: An alternate method of clamping the turntables to pivoted bolster has been provided at the request of the shippers.

Trial shipments showed this method of securing the turntable to be satisfactory.

Changes in rules governing the loading of boiler shells, machinery, etc.

Rule 302, New paragraph—Small diameter tanks, when more than one tank can be placed longitudinally (side by side) on flat or gondola cars shall be loaded as follows: Tanks weighing less than 3,500 lb. each may be loaded three, four, five or six tanks per pile, as per Fig. 101-A, Sections "B" and "A". Tanks weighing 3,500 lb. or over, must be loaded three tanks per pile as per Fig. 101-A, Section "B". Tanks loaded four, five or six per pile must be secured by three rods or bands per pile and when loaded three tanks per pile must be secured by two rods or bands, rods or bands must be secured to side of car, stake pockets or floor of car with suitable nuts and washers or cleats; threaded ends to be riveted over or checked to prevent loss of nuts. Rods must be at least ¾ in. in diameter, and bands must be of equivalent strength, with bolt ends welded on. Each layer of tanks, when not loaded in pyramidal form must be separated by at least two 3-in. by 4-in. bearing timbers having 4-in. by 6-in. chock blocks spiked to top and bottom of each bearing-timber. Side blocks on floor when loaded in gondola or flat cars, must be 4 in. wide by 6 in. high and applied as shown in Fig. 101-A for each pile of tanks, and when loaded on flat cars each block must be backed up by a 4-in. by 5-in. side stake. End blocking must be applied to other end of end piles. On gondola cars, the end blocking should be 4 in. by 4 in. spiked to floor with 60 penny spikes and on flat cars the end blocking should be 4 in. by 6 in. bolted to floor of car with four ¾-in. bolts with 2-in. by 4-in. by 12-in. cleats under floor. Tanks less than 8 ft. in length having flat ends, may be loaded on end in gondola cars, providing they are securely blocked and braced to prevent end shifting and falling over.

Changes in rules governing the loading of concrete culvert pipe, brick, stone, building tile, etc.

Rule 400—Manner of securing concrete culvert pipe loaded on flat cars: Pipe loaded on its side should be secured as per Fig. 109, 109-*A or* 109-*B, the method shown on Fig.* 109-*B to be followed for pipe loaded crosswise of car, when cars are not equipped with end stake pockets.* If loaded on end it should be secured as per Fig. 110.

EXPLANATION: New figures have been added to the rules to cover concrete culvert pipe loaded on its side crosswise of car. This method of loading is giving satisfactory results in actual service.

Rule 401, Second paragraph—Where separating strips to keep lading clear of car floor are referred to in these rules, they should be sound wood, not less than ***three inches*** wide by ***one inch*** thick. (The remainder of the paragraph is unchanged).

EXPLANATION: Thickness of bearing-strips changed from 1½ in. to 1 in. to overcome breakage of stone in transit.

Rule 417—Building tile, *unless otherwise covered by governing classification,* loaded interlocked at doorway do not require door protection if built up as per Fig. 113, and packed tight to prevent motion between tiling. (The remainder of the paragraph is unchanged).

EXPLANATION: Reference to the Classification has been incorporated in the rule to avoid confliction between the Loading Rules and Rule in the Classification covering this class of material being shipped.

Changes in rules governing the loading of automobiles

Rule 518, Paragraph (i)—*After* loading, emergency brakes should be set, *except on balloon tires, where it is optional.*

EXPLANATION: To set emergency brakes on automobiles equipped with balloon tires will damage the brake mechanism, due to the fact that constant jar in the car on account of the resiliency of the balloon tires would spread the brake bands when the brakes are set.

The report is signed by R. L. Kleine (chairman), assistant chief motive power, Penna.; R. H. Dyer, general car inspector, N. & W.; E. J. Robertson, superintendent car department, Soo Line; Samuel Lynn, master car builder, P. & L. E.; G. R. Lovejoy, master mechanic, Detroit Terminal; T. O. Sechrist, assistant superintendent machinery, L. & N.; C. J. Nelson, chief inspector, Chicago Car Interchange Bureau, and R. B. Rasbridge, superintendent car department, Reading.

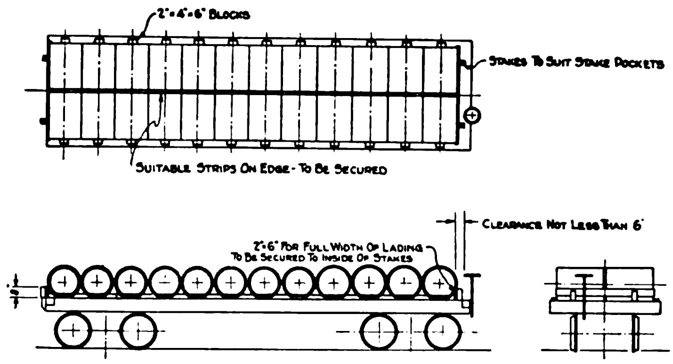


Fig. 109B—Manner of loading concrete culvert pipe on flat cars

Discussion

After presenting the report Mr. Kleine stated that the committee had a number of rules under investigation and new rules under consideration that were not completed up to the time of the convention. As the Loading Rules Committee works through the entire year, making trial loads at the request of the shippers, he asked that the members of the association consider some subsequent recommendations which the committee would make for inclusion in the letter ballot, accompanied by a full explanation.

The report was accepted subject to later changes as requested by the chairman of the committee.

Specifications and tests for materials

The report submitted by the committee recommended the withdrawal of one tentative specification, revisions of five standard specifications, revisions of eight practice specifications and the adoption of two new recommended practice specifications.

Withdrawal of specification

In 1921 the committee presented a new tentative specification for Chrome Molybdenum Alloy Steel Helical Springs. Inquiry has developed the fact that no use is being made of this specification except that one consumer had attempted to secure such springs with unsatisfactory results. The committee, therefore, recommends that this specification be withdrawn from the manual.

Revision of standard specifications

Specifications for Quenched and Tempered Carbon Steel Axles, Shafts and other Forgings, to be revised as shown. These specifications have been revised with the co-operation of the American Society of Steel Manufacturers' Committee on Axle Specifications to bring them into line with recent practice, mainly as regards form, and also to revise the section on proof tests. In the proposed modified form the two classes formerly called first class and second class according to size are changed to class A and class B. In the chemical composition the carbon content is increased slightly in class A. A change is made in the method of determining the elastic limit and the section relative to proof test has been amplified in accordance with the practice on the Pennsylvania System, New York Central Lines, Standard Steel Works Company and the Carnegie Steel Company.

In the proposed revision the paragraph covering chemical composition has been changed to show an increase in carbon and manganese, the omission of a specification for silicon and the chromium content for chrome-nickel steel decreased. The method of determining the elastic limit has been clarified and new material added relative to proof test.

Specifications for Welded Pipe to be superseded by two new specifications; one covering Welded Wrought Iron Pipe and the other Welded and Seamless Steel Pipe. This revision is for the purpose of covering wrought iron and steel pipe in separate specifications and making these specifications agree with present standard practice. The proposed specifications are more complete than the old specifications on welded pipe.

Specifications for Boiler and Firebox Steel for Locomotive Equipment to be revised so as to agree with recent standard practice and specifications of other societies. The proposed revisions change the carbon content for firebox steel, provide for a modification of elongation for material over ¾-in. in thickness by increases in 1/32-in. steps instead of by ⅛-in. steps and amplify the paragraph on marking.

Specifications for Rivet Steel and Rivets for Locomotive Tenders, Passenger and Freight Equipment Cars to be revised in agreement with standard practice as regards permissible variations in size in hot finished rivet bars.

Specifications for Carbon Steel Axles for Cars and Locomotive Tenders to be revised in order to provide additional tolerances where experience has shown such provision was necessary, and to cover certain changes in form in order to clarify the meaning. These revisions have been made in co-operation with the American Association of Steel Manufacturers' Committee on Axle Specifications. Allowable variations in turned diameters of smooth forged and rough turned axles have been increased. A change is also made in the section covering weights.

Specifications for Blooms, Billets and Slabs for Carbon Steel Forgings has the title changed to Carbon Steel Blooms, Billets and Slabs and Forgings. Chemical specifications for carbon and manganese have been revised for the purpose of bringing the different classes of steel in agreement with what is now standard. Clauses on analyses and chipping have been revised and amplified to clarify the meaning.

Specifications for Annealed and Unannealed Carbon Steel Axles, Shafts and other Forgings to be revised in order to bring the specifications in line with recent practice. The changes have been made in co-operation with the American Association of Steel Manufacturers' Committee on Axle Specifications. Modifications have been made in chemical specifications for carbon and manganese. The maximum speed of testing machine when making tension tests has been increased and provision made for three instead of only one retest. A rewording has also been made of the paragraph on workmanship.

Specifications for Malleable Iron Castings to be revised in order to bring them into agreement with current standards. Revision increases the minimum allowances for tensile strength and for elongation. Provision is also made for retests when bars fail on account of flaws.

Specifications for White Lead for Lettering to be revised in order to bring the specifications into agreement with current practice. Under chemical composition where it is now specified that the mechanical moisture combined with pigment and oil shall be not over 0.25 per cent by weight, it is changed to read, not over 0.70 per cent by weight.

Specifications for Boiled Linseed Oil to be revised in section 7. Loss on Heating by changing temperature figures of 115 to 125 deg. C. to read 105 to 110 deg. C.

Specifications for Raw Linseed Oil to be revised the same way.

Specifications for Turpentine to be revised in the paragraphs covering appearance, color and odor, also revision in paragraph 6 on other properties.

New recommended practice specifications

New specifications were submitted for Water Gage and Lubricator Glasses. These specifications cover three types of water gage glasses, namely, reflex, tubular and "bull's-eye," also "bull's-eye" type lubricator gage glasses. Specifications for physical properties and tests include optical test, dipping test, solubility test, pressure test and method of taking samples. Additional points cover permissible variations, workmanship and finish, wrapping and labeling, and inspection and rejection.

New specifications were submitted for Paint Reducing Oil used for mixing paste and semi-paste to the proper consistency of painting. The reducing oil to consist of not less than 35 per cent of fixed oil and drier with the remainder mineral spirits. The fixed oil to contain at least 50 per cent linseed oil, the remainder being drying or semi-drying oils. Specifications cover also special requirements, drying tests, elasticity test, number of tests and inspection and rejection.

The report is signed by F. M. Waring (chairman), engineer tests, Pennsylvania System; J. R. Onderdonk, engineer tests, Baltimore & Ohio; Frank Zeleny, engineer of tests, Chicago, Burlington & Quincy; A. H. Fetters, mechanical engineer, Union Pacific; H. G. Burnham, engineer of tests, Northern Pacific; J. C. Ramage, engineer of tests, Southern; J. H. Gibboney, chemist, Norfolk & Western; F. T. Quinlan, engineer of tests, New York, New Haven & Hartford; T. D. Sedwick, engineer of tests, Chicago, Rock Island & Pacific; G. N. Prentiss, engineer of tests, Chicago, Milwaukee & St. Paul; H. W. Faus, engineer of materials and equipment tests, New York Central; H. D. Browne, engineer of tests, Chicago & North Western.

Discussion

E. E. Chapman (A. T. & S. F.) said that the change in chemical specifications for firebox steel, which calls for the elimination of the lower limit in carbon is a step in the right direction but believed that consideration should be given to the lowering of the maximum limit for the carbon content for plates ¾ in. or under in thickness to not over 0.18 per cent and for plates over ¾ in. in thickness to not over 0.25 per cent carbon.

The committee recommended that the manganese in the thin plates have the upper limit reduced to 0.50 per cent in place of the present 0.60 per cent. Mr. Chapman objected to this recommendation because the manganese in moderate quantities is a cleanser of sulphur and phosphorus and produces greater resistance to the formation of cracks.

On motion, the report was accepted and referred to letter ballot of the division.

Report on safety appliances

Mr. Chambers: The committee has no written report this year. The principal work we have been engaged in is the arrangement for testing out the air brakes to comply with the Commission's requests in power brake appliance hearings. H. A. Johnson, our director of research, has a statement to make.

H. A. Johnson: The Director of Research was appointed in the early part of December, 1924, and instructed by the Committee on Safety Appliances of the Mechanical Division to proceed upon the following plan:

1—Steps will be taken to obtain appliances, which, it is claimed, meet the views of the Interstate Commerce Commission, as indicated in its preliminary report and conclusions. If the plans or specifications for such appliances are available and the appliances are not yet being manufactured, steps will be taken by the Director of Research to secure such appliances, even to the extent of entering into an agreement to have such appliances made.

2—As soon as such appliances have been obtained they will be given exhaustive tests on the test rack at Purdue University, which rack will be completely prepared and brought up to date for the purpose of this investigation.

3—Following the completion of the rack tests such devices will be given road tests, to develop whether or not they meet road conditions safely in service.

4—This program will be carried out with all dispatch and as promptly as the devices for these tests are available.

5—The investigation will also embrace such further study as may in the judgment of the Director of Research throw further light upon this problem.

In response to inquiries sent to the Westinghouse Air Brake Company, the Automatic Straight Air Brake Company, and the New York Air Brake Company, the American Railway Association has purchased from each of the first two named companies 150 sets of freight air brake equipments, which, it is claimed, meet the views of the Interstate Commerce Commission as indicated in its preliminary report and conclusions. Both companies are now manufacturing these equipments.

A contract between the American Railway Association and the Purdue University Engineering Experiment Station has been entered into covering the use of the facilities of the University during the rack tests, which will be made upon the American Railway Association test rack. The test rack has been redesigned and is now being rebuilt to represent two Type ET locomotive equipments and 100 modern freight car equipments. The test rack is being arranged to accommodate the several types of equipment which will be submitted for test and this necessitates lengthening the rack 25 per cent. An order has been placed with the Westinghouse Air Brake Company covering the two Type ET locomotive equipments and the necessary material for placing the rack in first-class condition. Practically all of this material is now at the University or has been shipped. The length of brake pipe per car is being increased from 42 ft., center to center of hose couplings, to 50 ft., center to center of hose couplings, which more nearly represents average present day conditions.

In the conduct of these tests automatic recording instruments will be used, wherever possible, to eliminate the human element in reading and recording results. As there were no instruments on the market suitable for this work, it has been necessary to design and develop new instruments. These instruments are now being manufactured.

The drafting of a schedule of tests, to which the various equipments will be subjected, is well under way. This schedule will include the American Railway Association code of tests and such additional tests as are necessary to develop the additional functions provided for in the preliminary report and conclusions of the Interstate Commerce Commisison. Upon completion the schedule of tests will be submitted to the Bureau of Safety of the Interstate Commerce Commission, the manufacturers submitting equipment and the Committee on Brakes and Brake Equipment of the American Railway Association, for their criticism and suggestions. It is to be understood that the schedule of tests may be modified or revised as the tests progress, if such modification appears desirable in the opinion of the Director of Research. The present standard Type K freight equipment will be tested first in order to establish a proper basis for comparative results. The Type K triple valves, which have been installed on the test rack for a number of years, will be replaced by the Westinghouse Company with new Type K triple valves.

It is expected that the rack tests will be started during the early part of September and be completed by the end of the year. The men who will act as official observers during the tests will be selected largely from the staff of professors and instructors of Purdue University who are skilled in carrying on scientific researches and who will be unbiased in their judgment. All work performed by the University staff will be under the direction of the Director of Research, who will be responsible for the conduct of the tests and the results obtained just the same as if the observers were on his own payroll. The Bureau of Safety of the Interstate Commerce Commission, the manufacturers submitting the equipment, and the American Railway Association will be invited to have representatives present during the tests.

No definite plans have yet been made in connection with carrying on road tests, as the nature of the road tests will depend somewhat upon the results obtained on the test rack. Road tests will probably not be undertaken before next spring or summer as the rack tests will not be completed before winter sets in.

The Director of Research is making semi-monthly reports of the progress of the investigation to W. P. Borland, Director, Bureau of Safety, Interstate Commerce Commission with copies to R. H. Aishton, President, American Railway Association, C. E. Chambers, Chairman, Committee on Safety Appliances and V. R. Hawthorne, Secretary, Mechanical Division. In this manner the Bureau of Safety and the officers of your Association are kept thoroughly informed of every move made and are given the opportunity of making suggestions as the work progresses.

As many of you as possible should visit the University sometitme during the conduct of the tests, or have your air brake man drop in for a few days to see how the work is going on. I would be very glad to have you come and have your suggestions.

Report of committee on wheels

The new cast iron wheel specifications adopted in 1923 are now in general use and appear to be meeting with approval both from the users and the manufacturers. It has been found in practice that the extra requirements in these specifications, as compared with the old, have not caused the manufacturing difficulties which were anticipated by some makers. There is no question but what these specifications are proving a help in getting better wheels.

During the year your committee has discussed the question of still further increasing the requirements of the specifications, particularly as regards thermal test, in an effort to get further protection against cracked plate wheels. A considerable number of experiments must be made before any such recommendation could be presented by the committee, and it is planned to go into this question during the coming year as well as to hold conferences with the manufacturers in regard to same. Consideration will also be given to the inclusion in the specifications of a prescribed method of chemical analysis.

Developments in cast iron wheel design

During the year your committee has been watching the developments in the design of cast iron wheels. They witnessed the making of wheels with a lip chill at one foundry and examined some which had been in service for a number of years, in order to get an idea as to the relative merits of these lip chill wheels and the sand rim type. Wheels of both types were broken under the drop and examined to determine the nature of the metal at the rim. The committee came to the conclusion that the lip chill wheel is less liable to chipping of rim, and that a saving may be accomplished by its use since there are a very large number of wheels removed from service because of chipped rims.

The most interesting development in cast iron wheels is the single plate design. Tests which are being made of the 850-lb. single plate wheels in engine tender service have not progressed sufficiently to warrant the committee making any report on them. Up to the present time we know of no single plate wheels of lesser weight which have been put to service, but we anticipate that some such wheels will be produced and are hopeful that they will prove a help in the reduction of cracked plate wheels, particularly in high speed freight service, such as in refrigerator cars. There has undoubtedly been a radical improvement in the cracked plate wheel situation since the adoption of the heavier arch plate designs. However, cracked plates are still a problem and your committee hopes to co-operate with the manufacturers in an effort to still further improve the designs of the wheels.

Grinding of cast iron and steel wheels

Your committee made a series of tests on a wheel grinding machine in the shops of one of the member railroads. The grinding machine is built by the Norton Company, Worcester, Mass. The machine is motor connected by chain drive to a shaft which in turn is connected to the grinding wheels and drive for wheels in lathe by flexible leather belts. The grinding wheels cost $27.52 each and average about 200 slid flat cast iron wheels before they are replaced by new grinding wheels. The machine is operated by one man employed at a rate of 62 cents an hour.

Grinding cast iron wheels removed from service on account of slid flat spots, the lathe will average two pairs of wheels per hour or 16 pairs per eight hour turn. Grinding steel wheels removed on account of slid flat spots, the average output would be

somewhat greater as the time required per pair of steel wheels is less than per pair of cast iron wheels. Grinding new cast iron wheels to insure rotundity, the output is four pairs per hour or 32 pairs of wheels per day average.

The second pair of new wheels applied in the lathe were cast by the Griffin Wheel Company for refrigerator car service, 700 lb. wheels, September 15 and September 26, 1924, tape 3, A. R. A. 1917. Application of a gage prior to the grinding operation indicated lack of rotundity of about 1/32 in. During the grinding, this out of round condition became apparent as soon as the grinding wheel was applied to the wheel tread and wheels were revolved in the lathe. It should be noted that unless a gage is used, a considerable number of new cast iron wheels would be swung into the grinding machine needlessly. Considerable labor and time can be saved by the use of a rotundity gage applied to the journal with contact point in the center of the wheel tread, the wheels to be rolled on the track and the contact of the gage point with the tread noted.

Grinding slid flat rolled steel wheels

A pair of slid flat rolled steel wheels with good flanges were selected for test and one wheel of the pair was ground to correct the slid flat spots, the mate wheel later being turned in a wheel turning lathe. On the first wheel, one slid flat spot was 3 in. in length and two additional spots totaled 4 in. in length. The grinding operation resulted in a loss in wheel diameter of 1/16 in., a reduction in tape size from 262 to 260½ or a loss in service metal of 1/32 in. The mate wheel, with a slid flat spot 3¼ in. in length, was placed in a turning lathe for turning in accordance with ordinary practice. The saving in service metal for the pair of wheels if ground instead of turned would amount to 3/16 in. service metal per wheel at $2.03 or 6/16 in. for the pair of wheels, which represents a total saving in value of service metal of $12.18. It should be noted further that the labor for the grinding operation was less than one-quarter hour at 63 cents per hour for grinding as compared to a labor item of three-quarters hour at 75 cents per hour for the turning operation is a considerable saving over the old method.

One of the principal objections which has been raised against the practice of grinding slid flat wheels has been based on the fear that a ground wheel would develop a comby spot at the same location as the original flat spot due to thermal cracks. The best answer to this contention is the experience of those roads which have been following this practice for many years. This shows that these comby spots do not develop. In fact the records show that some wheels have been ground three times. It is important however that the wheels to be ground be carefully selected and only those in good condition except for the flat spot be ground. No shelled, comby or badly tread worn or flange worn wheels should be considered for the replacing of these wheels after grinding would not be considered good practice.

It is estimated that a grinding machine, completely installed, will cost $10,000. It is interesting to note that it has been the experience of one road that a large percentage of the cast iron wheels removed on account of slid flat spots were new wheels. This is probably due to the tendency of out of round wheels to be bound in the trucks by the brake shoe application resulting in slid flat spots in cast iron wheels. It follows naturally that when new wheels are placed in the machine and ground after mounting, the number of wheels removed on account of slid flat spots would be reduced to a considerable extent and that further the loss incident to scrapping of new cast iron wheels removed from service on account of slid flat spots is greater than appears to be the case when considering the difference in value between new cast iron wheels and second hand cast iron wheels than scrap cast iron wheels under A. R. A. Rules of Interchange. For instance, the A. R. A. price quoted for 750-lb. cast iron wheels new is $17.40; second hand value $9.55; and scrap $6.30. To reclaim the wheels as second hand rather than scrap results in a saving of $3.25 per wheel or $6.50 per pair, but this does not represent the actual saving for wheels reclaimed after removal from service on account of slid flat spots on comparatively new wheels. Furthermore, these wheels are better than the average second hand wheel since wheels with badly worn flanges, brake burns, etc., are not ground. To the actual saving of $6.50 in value of the wheels should be added the saving represented by cost of dismounting, remounting, boring, etc., and other operations necessary for the completion of the work.

Cost of grinding slid flat cast iron wheels

Labor ½ hour at 62 cents	31 cents per pair
Interest and depreciation at 10 per cent, $10,000 first cost (1924 price), 3,000 pairs ground per year	33 cents per pair
Power 12 k.w.h. at 1½ cents	18 cents per pair
Grinding wheels at $55 per pair	37 cents per pair
150 pairs wheels ground per pair grinding wheels	
	$1.19 per pair
Saving per pair based on second-hand values	$5.31
Saving per pair based on new values	$21.01

Gage for re-mounting wheels

There has been considerable controversy in regard to the use of the cast iron wheel re-mounting gage shown on pages 45 and 46 of Section B of the Manual. It appears that these gages have been used improperly by some railroads and such use has resulted in the wastage of serviceable material. This gage provides for a satisfactory and definite way of classifying second hand cast iron wheels as between scrap and second hand for billing purposes. It was never intended for steel wheels, though some of the roads have been using it in their shops for this purpose. In order to clarify this matter, the committee recommends that the title for this gage be changed to read: "Limit Gages for A. R. A. Billing Classification of Second Hand Cast Iron Wheels." (The committee felt that there was no need for both of the remounting gages shown on page 45 (Section B) of the Manual and recommended that the second figure on this page be eliminated and the title under the first changed so that it will refer to all cast iron wheels. Since the maximum wear limit on flanges is 1 7/16 in., it was also felt that 1 5/16 in. is a fairer limit than 1 3/16 in. The committee report also included an explanation of Interchange Rule 24, and some important recommendations regarding the mounting of wheels, the use of pressure gages for wheel presses and mating of steel wheels.—Editor.)

Questionnaire on steel wheel wear and contour

In accordance with the committee's 1924 report, a questionnaire was sent to all railroads to gather information as to their practice regarding tread wear of steel wheels and also as to the desirability of using a standard contour for driving tires and all other wheels, particularly to determine if a 1 in. flange height for driving tires would be satisfactory. This questionnaire developed the fact that there was a great difference of opinion on these questions. The vote was approximately evenly divided for and against the 1 in. flange on drivers, though the majority stated that it would be advantageous from a shop viewpoint. Your committee is of the opinion that the 1 in. flange, which incidentally is being used by a number of roads and is used on engine truck wheels, should be standardized. However, in view of the large number of roads opposing such practice, your committee will not make such recommendation at the present time, but will continue its observation of results secured by those roads who are using this type of flange on driving tires.

Steel wheel specifications

During the past year your committee has given a large portion of its time to the consideration of wrought steel wheel manufacturing processes. A sub-committee has visited the plants of most of the manufacturers and studied the various processes used. We have also held a conference with the representatives of the different manufacturers and upon our request they have formed a technical committee to work with your committee in the development of the wrought steel wheel. A suggestion was made that the specifications be changed to include a number of new requirements regarding process of manufacture. After a conference with the manufacturers, your committee decided that a better procedure would be to work out the various problems involved through the technical committee and leave the specifications as they are, at least, for another year, pending the results of these further studies. The service to which steel wheels are being put is becoming more and more exacting, particularly in locomotive tenders, and improved processes are necessary to fully meet these requirements. We are glad to report that the manufacturers, by the formation of this Technical Committee, are showing a spirit of co-operation in working toward a solution of these difficulties and we are very hopeful that the next year will produce changes and improvements which will prove most helpful to the users of wrought steel wheels.

Your committee has found that there are very few 38 in. wrought steel wheels now in service and they therefore recommend that such wheels be removed from the standards of the Association.

Limits of wear on rolled steel wheels

At the last meeting the committee recommendation to reduce the limit of wear for rolled steel wheels in switch engine tender service was approved. The matter was referred to Mr. Pack of the Interstate Commerce Commission and he has issued a ruling permitting this lower wear limit under the I. C. C. Inspection Rules. The railroads are therefore able to take advantage of this further saving of wheels.

The committee was requested to consider reducing the limit of wear on all tender wheels and also on all passenger wheels. Though all the reports indicate that no trouble is being experienced with the lower wear limit in freight cars, your committee does not feel that sufficient experience has been had with these lower limits to warrant their making such recommendation at this time. We wish to protect passenger car and engine service in every possible way and it should be remembered that passenger car wheels worn to 1 in. need not be thrown away as they can then be transferred to freight service. All of the roads are not taking advantage of this possible extra service of wheels, and the committee urges that they give it consideration.

The rolled steel wheel is not permitted to be worn under passenger cars or under tenders of road engines to less than 1 in. rim thickness. It is probable that this amount of dead or unused metal is more than safety requires. This limit was established in the days when steel wheels were mostly steel-tired with an independent center. This type of wheel did not have the strength in the rim which is possessed by the single plate rolled steel wheel of today. It seems reasonable that the rim of the more modern rolled steel wheel can be worn to a thinner section than can the rim of the steel tired or assembled wheel. If this is correct, the present standard of 1 in. thickness at which rolled steel wheels are condemned from passenger service and road engine tenders, wastes some metal in each wheel.

In order that the railways may be supplied with the best information available as to what is safe and advisable in this matter, it is recommended that a questionnaire be sent each railway for its filling out with the results of its experience and its views. This questionnaire is to be worded so clearly that it cannot be misunderstood, and to develop data which can be compiled on a common basis for conclusions.

Manual of wheel shop practice

In accordance with statement made in our 1924 report, we have prepared a manual of wheel shop practice. The committee has devoted a large amount of time to the preparation of this book and we are presenting it for your consideration at this time with the understanding that it is not a fully finished piece of work. The section covering classification and causes of defects is particularly needful of further study and development. The committee believes that thru co-operation with the technical committee of the wrought steel wheel manufacturers during the coming year more conclusive information will be developed. Undoubtedly, there will be found many features which can be improved upon and the committee presents it with the request that during the coming year the members furnish criticisms and suggestions for changes and it is hoped by the end of another year the committee can revise the Manual so as to put it in finished shape for issuance to those interested.

(The committee here inserted a copy of the proposed manual of wheel shop practice, which is profusely illustrated and contains 20 main subdivisions of this important work. It forms a 100-page booklet.—Editor.)

The report was signed by C. T. Ripley, chairman, chief mechanical engineer, A. T. & S. F.; O. C. Cromwell, assistant to chief of motive power and equipment, B. & O.; H. E. Brownell, general foreman foundry, C. M. & St. P.; G. B. Koch, general foreman foundry, Penna.; H. W. Coddington, engineer tests, N. & W.; A. Knapp, inspection engineer, N. Y. C.

Discussion

The discussion of this report was opened by Mr. Ripley, who stated that the committee wished to withdraw the recommendation that the title of the remounting wheel gage be changed, as this might cause controversy.

A. H. Fetters (U. P.) read a prepared discussion by O. S. Jackson (U. P.), in which he commended the disposition made of the question of the proper limit for wear for rolled steel wheels under switch engine tenders, stating that with the new method many dollars will be saved. He went on further to state that one of the most perplexing and annoying problems coming to the attention of the railroads has been the large proportion of rolled steel wheels removed from heavy road tenders on account of being shelled out. While admitting the heavy loads imposed, it seems that the material is not what it should be and offers an opportunity for investigation by the wheel committee during the coming year.

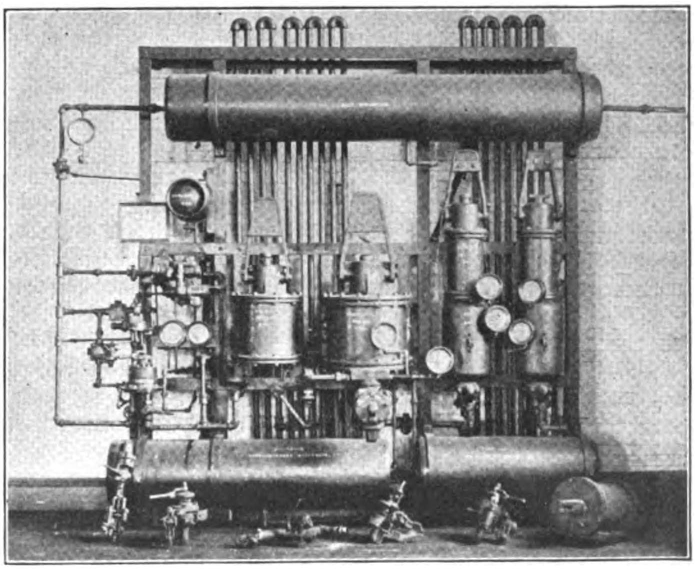
A. E. Calkins (N. Y. C.) presented a prepared discussion. He stated that with a few minor exceptions, the 1923 cast iron wheel specifications were incorporated in the New York Central specifications as of January 1, 1925, and present indications show that excellent results may be anticipated from these wheels. He said that the remounted gages shown in the manual have never been used on his road for remounting determinations, as the flange thickness requirement of these gages is too severe and if recognized would result in an alarming economic loss.

The N. Y. C., he said, intends to try out the wheel axle centering gage as it is superior to the existing method of measuring. He took exception to the suggestion that a more general use of hydrauligraphs be obtained through a provision in the interchange rules, stating that it is N. Y. C. practice to insist on the general use of the autographic type and to require press operators to show the axle size as well as the wheel number in order to carry out the checking of wheel mounting data in the general offices in addition to the surprise checks made during the day.

Mr. Calkins expressed the hope that during the coming year the wheel committee would investigate and incorporate in the manual some further data and perhaps drawings of fillet gages for various journals which will tend to increase the life of axles. He also suggested that the committee include in the manual a provision to the effect that wheel shops should stencil on each end of the axle inside of the wheel seat, the actual diameter of each wheel seat. This, he said, proves of great value to billing clerks at shops where wheels are applied.

Interesting comments were made by G. S. Goodwin (C. R. I. & P.) pertaining to the grinding of slid flat wheels. He stated that for the past month, his road had tried out with success a new portable wheel grinder reclaiming slid flat wheels by grinding off the high spots on a 14-in. arc on the wheel circumference. On 12 pairs of wheels ground, he said, a total of 251 min. was required, which gave an average of 21 min. per wheel at a cost of 40 cents which did not include electrical current or shop prorata; the flats varying between 2½ in. and 3 in. and the metal removed ranging from 3/64 in. to 1/16 in. All of the wheels thus ground, he said, had been restored to service on the road's own equipment and up to the present time, no reasons have been discovered why this treatment should not be continued.

The report was accepted and referred to letter ballot.



Air brake demonstration equipment used for instruction purposes at Yale University

Character of wheel and rail contact

Above critical speed flat spots or track depressions cause contact failure — Spring supported brakes amplify this condition

By John P. Kelly

Senior engineer, Bureau of Signals and Train Control Devices, Interstate Commerce Commission

THE sliding of wheels while brakes are applied for the purpose of controlling the motion of a train is a decidedly objectionable occurrence which should be provided against mechanically as effectually as possible. Everyone fairly well informed concerning the braking art knows that it is on the practically continuously maintained frictional resistance between the wheel and the rail, during the time the brake shoes are pressed against the wheel peripheries that the brake is dependent for its efficacy in retarding the motion of the train.

If the magnitude of the frictional force excited between the wheel and the rail during the time brakes are applied, acting to keep the wheel rotating, is constantly maintained

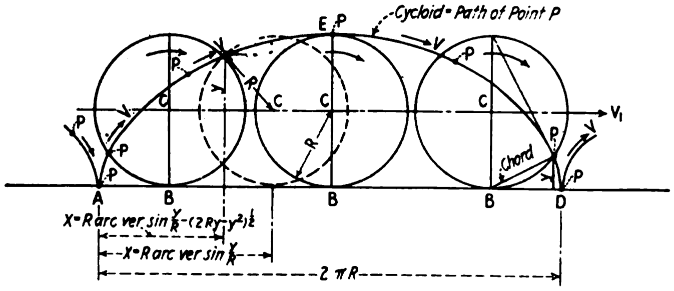


Fig. 1

equal to the brake shoe frictional force, acting at the periphery of the wheel to stop its rotation, the vehicle will come to a stop without wheel sliding.

Experiment has amply demonstrated that the coefficient of friction which exists between the wheel and the rail, while the former is motionless, is about 0.32 of the weight resting on the rail under the wheel at the point of contact; hence the maximum resisting force which the brake can oppose to starting the car from a state of rest must equal the weight carried to the rail multiplied by this coefficient. While a car is in motion, assuming that the wheel and rail contact is constant and also that the weight carried to the rail is constant and equal in magnitude to that impressed upon it when the car is motionless, could we develop a braking frictional force at the periphery of the wheel equal to 0.32 of the weight of the car we should then be able to stop it on a level track from a speed of 60 miles per hour in a distance of about 376 ft. and in 8.5 seconds from the point and from the instant of application of the brake.

In the theory of train braking the first and most important consideration is, then, that of the character of the wheel and rail contact, whether constant or intermittent, while the car is in motion; and if intermittent, to what degree it is so and why. In what follows the ideal and the actually existing conditions touching upon this matter will be considered.

Theoretically, a perfectly circular wheel, rolling without slipping on the surface of a perfectly level track at any speed, will always have its rail contact point stationary with respect to the rail.

Let the circle shown in Fig. 1 start to roll in the direction indicated by the arrow, the point P being in contact with the straight line $A\ D$ at the commencement of the rolling motion. At the completion of one rotation the center C will have moved parallel to the line $A\ D$ a distance equal to $2\ \pi\ R$ the circumference of the circle, R being the radius and $\pi = 3.1416$, being the ratio of its circumference to its diameter.

The point P, during this rotation, will have turned through one complete revolution about the center C; it will also have advanced horizontally the same distance as the center C, and be again in contact with the line $A\ D$ at D. The path in space traced out by point P during this rotation is indicated in the curve $A\ E\ D$, which curve is the well known cycloid.

It is evident from an inspection of the figure that when P comes to the line $A\ D$ it is motionless with respect thereto, for, the rotation continuing, the direction of the

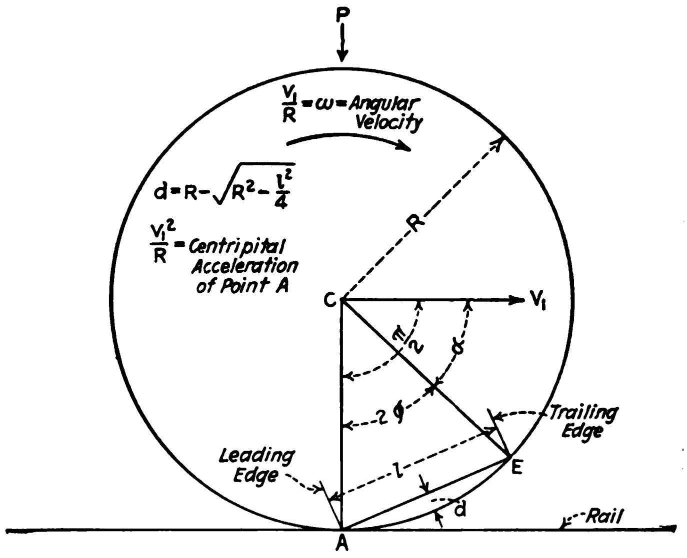


Fig. 2

motion of P changes to the opposite of what it was in coming to the line. This fact, as well as that of the variable cycloidal velocity of P at different points in the curved path may be proved mathematically. Referring to Fig. 1.

Let V = the velocity of point P at any position in its cycloidal path,
V_1 = the velocity of the center parallel to the line AD,
R = the radius of the circle,
x = the abscissa which coincides with the point of contact on line AD, on which the circle rolls, and
y = the ordinate to any point of the cycloid. The center C moves at the same rate as the successive points of contact B, and it is always vertically over B.

From the equations of the cycloid shown in Fig. 1 and the theory of curves it may be demonstrated that

$$V = \sqrt{\frac{2y}{R}} \times V_1$$

Hence if $y = O$ then $V = O$, the contact point is motionless with respect to the line AD

$y = R$ then $V = \sqrt{2}\, V_1$

$y = 2R$ then $V = 2V_1$

$y = \frac{R}{2}$ then $V = V_1$

The velocity of any point in the circle, corresponding to or coinciding with any point in the cycloidal curve, is the same with respect to the straight line on which the circle rolls as that which it would have if the whole circle revolved about the point of contact at the same angular velocity as that of the generating circle itself. For the length of the chord which corresponds to the ordinate y, Fig. 1, (at the right) as may be easily discerned from its geometry, equals $\sqrt{2\,Ry}$, and hence if

$$V : 2V_1 :: \sqrt{2\,Ry} : 2R$$

We again have $V = \sqrt{\frac{2y}{R}} \times V_1$

From the foregoing it is clear that, at the instant any point of the circle is in contact with the line, it has no velocity with respect thereto, and the velocity of the highest point, diametrically opposite the contact point, is twice that of the center.

Cause of intermittent wheel and rail contact

Were this ideal condition to obtain practically for the car wheel rolling along the rail surface, then no justifiable exception could be taken to the statement so generally made, that the coefficient of friction between the rail and the wheel has the same constant value while the wheel is rolling as it has while the wheel is motionless. Unfortunately, however, this ideal condition never obtains in practice for the rolling car wheel, and because it does not, the wheel and rail contact pressure, while a car is in motion, is of a variable and intermittent character.

We shall now consider the conditions which affect rail contacting of the rolling car wheel, using the case of the rotating flat wheel for illustration. This will enable us, although it is not of prime importance here, to determine at the same time the striking velocity of the flat's trailing edge.

Car wheels, as customarily assembled in trucks, always carry a spring supported load, a fact that should be kept in mind during the discussion which follows:

Referring to Fig. 2, let

R = radius of the wheel in feet,
l = length of flat spot in feet.
d = depth of flat spot in feet,
V_c = criticial speed of the wheel in feet per second,
V_1 = velocity of the center of the wheel, parallel to rail, in feet per second,
V_s = striking velocity in feet per second of the trailing edge of the flat spot,
ω = angular velocity of the wheel,
P = pressure of the truck equalizing spring, in pounds, on the wheel (considered the same as when the wheel is stationary),
W = Weight of wheel in pounds (this weight to include weight of all parts of the truck not spring supported),
g = acceleration of gravity = 32.2 feet per second per second

Then,

$$d = R - \sqrt{R^2 - \frac{l^2}{4}}$$

$$a = \frac{\pi}{2} - 2\,\phi = \frac{\pi}{2} - 2 \text{ arc sin } \frac{l}{2R}$$

When the wheel is in the position shown in Fig. 2 it is instantaneously turning about the point A, the leading edge of the flat spot, and the resultant vertically upward acceleration of $A = \frac{V_1^2}{R}$ feet per second per second. The whole wheel has, at the same instant, due to the downward pressure of the truck equalizing spring, avertically downward acceleration equal to

$$\frac{P + W}{W} \times g = g_1 \text{ feet per second per second.}$$

The upward acceleration $\frac{V_1^2}{R}$ and the downward acceleration g_1 are directly opposed to each other; hence the critical speed for point A will occur when the magnitude of the opposed accelerations are equal, that is, when

$$V_1 = V_c = \sqrt{g_1\, R} \text{ feet per second.}$$

Before the critical speed is attained the striking velocity of point E, the trailing edge, will be given very nearly by the expression

$$V_s = \frac{l}{R}\, V_1$$

from which it is clear that for any given wheel and flat spot the velocity with which the trailing edge will strike the rail will increase proportionately with the speed from

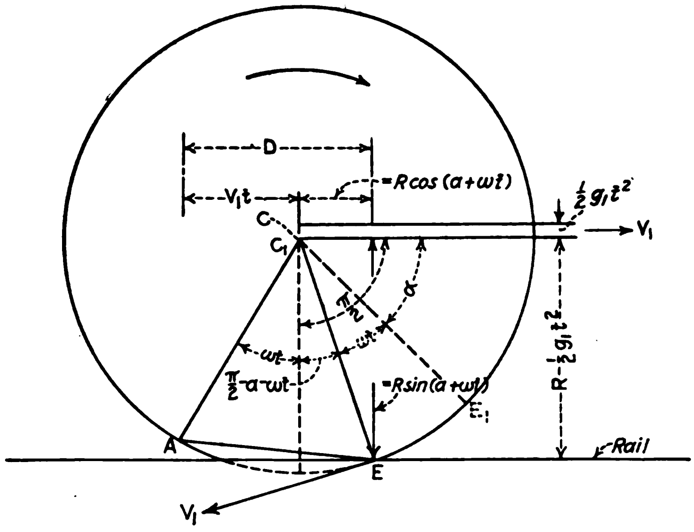


Fig. 3

zero up to the critical speed, that is, up to when

$$V_s = \frac{l}{R} \times \sqrt{g_1\, R} = l\sqrt{\frac{g_1}{R}}$$

after which, as the equation shows, it remains practically constant regardless of increase of velocity. This means, of course, that after the critical speed has been slightly exceeded the leading edge of the flat spot rises off the rail before the trailing edge strikes it, that is, the wheel breaks its rail contact at the flat spot completely.

In view of the important part which the truck equalizing springs play in the prevention of wheel sliding during brake applications made to control the motion of the car, the following explanation of the fact that the leading edge of the flat does actually rise off the rail before the trailing edge strikes it, is submitted:

When the velocity of the wheel's rotation has reached the value where

$$V_1 = V_c = \sqrt{g_1\, R}$$

let t seconds equal the elapsed time betwen the rising off the rail of point A and the striking of point E. During this interval the path of E will be the resultant of three distinct motions (see Fig. 3), namely:

1—Translation; that of the wheel as a whole which moves V_1t feet horizontally forward:

2—Vertically downward as a whole $\frac{1}{2}g_1t^2$ feet; and one of

3—Rotation, or angular motion ω, that of the wheel about its own center through the angle ωt during which E moves from E_1 down to the rail at E. Hence

$$\frac{1}{2}g_1t^2 + R\sin(a+\omega t) = R \quad \text{(1)}$$

The distance between the point of departure of A and the point of striking of E is

$$D = V_1t + R\cos(a+\omega t) \text{ feet.}$$

At the instant of striking, the vertical downward velocity of the whole wheel is g_1t feet per second. The velocity of E, due to rotation about the center C is V_1, perpendicular to CE. Its vertical component is

$$V_1\cos(a+\omega t)$$

Therefore, the vertical striking velocity of point E, the instant it comes to the rail, is

$$V_s = g_1t + V_1\cos(a+\omega t) = g_1t + R\omega\cos(a+\omega t) = g_1t + R\omega\sin\left(\frac{\pi}{2} - a - \omega t\right)$$

But since $\left(\frac{\pi}{2} - a - \omega t\right)$ is a very small angle we may say

$$V_s = g_1t + R\omega\left(\frac{\pi}{2} - a - \omega t\right) = t(g_1 - R\omega^2) + R\omega\left(\frac{\pi}{2} - a\right) \quad \text{(2)}$$

From equation (I)

$$\frac{1}{2}g_1t^2 + R\cos\left(\frac{\pi}{2} - a - \omega t\right) = R$$

and as before $\left(\frac{\pi}{2} - a - \omega t\right)$ being small we may place

$$\frac{1}{2}g_1t^2 + R\left[1 - \frac{\left(\frac{\pi}{2} - a - \omega t\right)^2}{2}\right] = R$$

so that solving for t we get

$$t = \frac{\frac{\pi}{2} - a}{\omega + \sqrt{\frac{g_1}{R}}}$$

Substituting this value of t in (2) we obtain

$$V_s = \left(\frac{\pi}{2} - a\right)\left[\frac{g_1 - R\omega^2}{\omega + \sqrt{\frac{g_1}{R}}} + R\omega\right]$$

$$= \left(\frac{\pi}{2} - a\right)\left[\frac{g_1 + R\omega\sqrt{\frac{g_1}{R}}}{\omega + \sqrt{\frac{g_1}{R}}}\right]$$

$$= 2\ \text{arc sin}\ \frac{l}{2R} \times \sqrt{g_1R}$$

For small flats, three inches or less in length.

$$\text{arc sin}\ \frac{l}{2R} = \frac{l}{2R}; \text{ therefore}$$

$$V_s = 2\frac{l}{2R} \times \sqrt{g_1R} = l\sqrt{\frac{g_1}{R}},$$

as before stated, showing conclusively that after the critical speed is exceeded the entire weight carried to the rail by the wheel is removed therefrom at each revolution, as the flat passes directly under the wheel's center; and that the striking velocity of the trailing edge of the flat becomes practically constant and independent of the speed of rotation.

For a 36-in. wheel, having a 2-in. flat, which carries a spring supported load of 12,500 lb., and under the spring 1,250 lb., the critical speed at which the leading edge of the flat rises off the rail is about 22 ft. per second or about 15 miles per hour; and the constant striking velocity of the trailing edge of the flat spot is about 2.5 ft. per second.

Practically, all car wheels may be said to have infinitesimally small flat spots in their peripheries; that is, their peripheries are never geometrically perfect circles however carefully they may be formed in the molds or turned in the lathe. Again, when the wheels are mounted on their axles the geometrical axes of the wheel and axle rarely coincide so as to be identical, although it is only in rare cases that the peripheries of wheels vary sufficiently from being perfect circles or the axes from coincidence to make the difference of great moment; but these points are mentioned merely to show that so far as the wheel is concerned it does not, even if it were rolling along a perfectly level rail surface, carry to the rail during every instant of time and at every point in its periphery, above certain critical speeds, a uniform pressure the equivalent of the load it is carrying, and this for the same reasons that, as just explained, the flat wheel does not do so.

A casual glance along the surface of the track of any railroad will disclose more or less undulating variations in it, the magnitude of which will depend largely on the character of maintenance, and on weather conditions generally; the character of the rail surface is a consideration of very great weight, as affecting the magnitude and constancy of the pressure between the rail and the rotating wheel.

But with the best practicable track maintenance and under the most favorable weather and temperature conditions it is impossible to maintain track surface uniformly smooth and even. In track laid with brand new rail, after a period of four or five years, if the traffic be heavy, the surface of the rails will be found higher at the rail centers than at the ends, where the track is laid with even joints; and where laid with broken or staggered joints, the surface will be lower at the centers and higher at the quarters. This condition of surface results from the action of the rotating wheels over it, cold rolling the surface metal and, consequently, rendering it more or less undulating in character.

Effect of brake shoe suspension on intermittency of contact

Taking the combination of the more or less flat condition of the wheel with the uneven rail surface it is quite evident that while the speed is above the critical point, the contact between the wheel and the rail is of a highly intermittent character, and that it remains such until the velocity reduces to a point below the critical when it becomes constant and remains so until the stop.

We shall now consider the effect which a brake application produces on the wheel and rail contact intermittency where the brake shoes are suspended from some spring supported portion of the truck. *Where the brake shoes are hung under the spring, a brake application does not affect the intermittency of contact.*

Fig. 4 represents one of the wheels of a six wheel passenger equipment truck, fitted with the single shoe type of brake rigging, with the brake released, and with the brake shoes hung far below the wheel center. The truck equalizing spring is shown normally distended and in condition to provide the deflection necessary for com-

fortable riding, so that the vertically downward acceleration of the wheel is, as before shown,

$$\frac{P + W}{W} \times g = g_1$$

In Fig. 5 the same wheel and truck brake rigging is shown, with the brake heavily applied, the magnitude and direction of the resolved brake shoe pressure indicated, the resultant vertical force between the truck equalizer and the top rail of the truck frame indicated by the vector *A*, sufficient to compress the equalizing spring solid and to hold it in the solid compressed state as long as the brake remains applied with the same force.

The force indicated by the vector *B*, though normally impressed on the truck pedestal jaw, causes a high frictional resistance to vertical movement of the journal box,

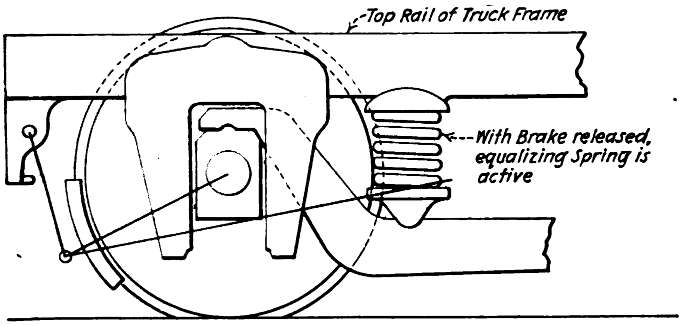


Fig. 4

and thus aids in holding the box rigid in the pedestal jaw.

Assuming that the ratio of the spring supported weight to the non-spring supported weight, or weight under the spring, is 10, the accelerating effect of the equalizing spring on the wheel, while the brake is released, as shown in Fig. 4, is 322 ft. per second per second; and when the brakes are applied, as indicated in Fig. 5, it is only 32.2 ft. per second per second.

This difference in the accelerating effect of the equalizing spring produces a condition which is highly conducive to wheel sliding; first by increasing the length of the non-contacting of the wheel and rail, and secondly by lowering the point of the critical speed.

Referring to Fig. 7, let the ratio of the spring supported

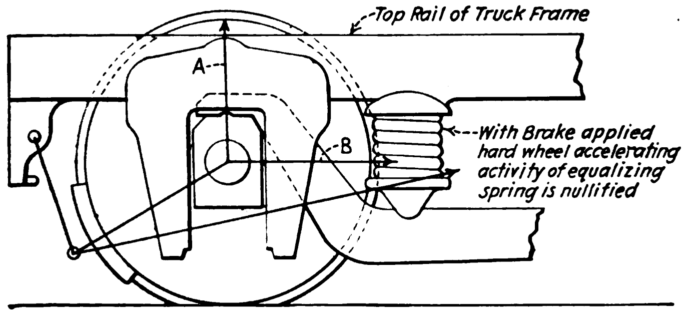


Fig. 5

weight to the non-spring supported weight be 10 as before, and the speed of the vehicle 88 ft. per second (60 miles per hour), then the wheel, if rolling into a rail depression 1/64 in. deep and of sufficient length, with brake released as indicated in Fig. 4, will lose its contact with the rail, removing entirely its pressure therefrom for a distance of 10.4 in.; if the equalizing spring be compressed solid so that the wheel and journal box is held rigid in the pedestal jaw, as indicated in Fig. 5, the contact will be lost for a distance of very nearly 33 in., so that over the distance indicated no rail frictional force is acting in opposition to the brake shoe frictional force tending to stop the wheel's rotation.

The only force during the non-contact period opposed to the brake shoe frictional force is the rotative energy within the wheel itself.

A pair of 36-in. wheels and an axle, such as is generally used in the six-wheel truck under a car weighing 150,000 lb. will weigh about 3,200 lb. The square of the ratio of the radius of gyration in such a pair of wheels and axle to the square of the radius of the wheel is about 0.55, and the rotating energy in foot-pounds of such a pair of wheels and axle at 88 ft. per second will be given by the formula.

$$E_R = \frac{W K^2 V^2}{2 g r^2}$$

in which

E_R = rotating energy in ft.-lb.
r = radius of wheel
V = linear velocity of a point r feet from the axis in ft. per second
W = weight of wheels and axle in lb.
K = radius of gyration, and
g = 32.2

Then substituting values for letters in the formula we have $\dfrac{3{,}200 \times 0.55 \times 88 \times 88}{2 \times 32.2} = 211{,}637$ ft.-lb. At 88 ft. per second, with a braking ratio of 165 per cent the coefficient of brake shoe friction is about 10 per cent. Hence, in the case of the wheel that carries a weight of 13,500 lb. to the rail we have a shoe pressure acting on

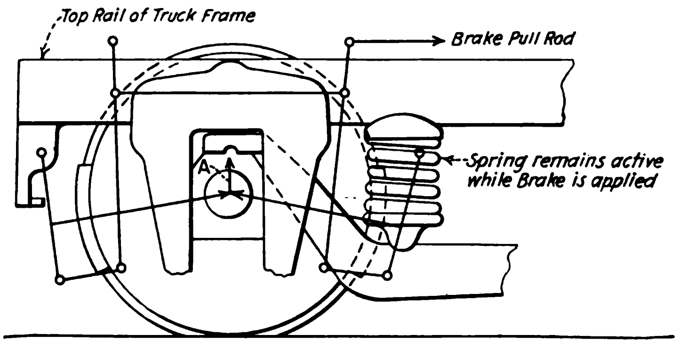


Fig. 6

the periphery of the wheel, taking the efficiency of the brake rigging at 85 per cent, of 1.65 × 0.85 × 13,500 = 18,933 lb., and the actual brake shoe frictional pull that will be exerted at the periphery of the wheel will be 18,933 × 0.10 = 1,893 lb.; and for the pair, 3,786 lb. If contact with the rails is lost for a distance of 33 in., or 2.75 ft., then the work done on the wheel while thus out of contact will be 3,786 × 2.75 = 10,412 ft.-lb.

When the wheels again come in contact with the rail at the end of the 33-in. non-contacting space their peripheral velocity will be approximately 85.5 ft. per second, or about two feet less per second than the speed of translation. Here then it may be seen that the very small depression of 1/64 in. will, under the truck brake conditions assumed, cause an incipient wheel sliding which, assisted by the various pull rods in the truck transferring weight from one pair of wheels to another, as is usually the case, will cause one or more pairs to slide.

Again when nearing the end of the stop, the truck equalizing spring remaining compressed, the critical speed instead of being 22 ft. per second becomes 7 ft. per second, or a little less than five miles per hour; so that the wheel sliding at the end of the stop, so frequently observed, and also the tendency of wheels, slightly flattened in previous stops to slide more easily in subsequent stops,

is satisfactorily explained by the compressed condition of the equalizing spring preventing continuous rail contact.

The intermittent contact and non-contact occurring in quick succession at high speed with the brakes heavily applied tends to cause rapid deceleration of peripheral velocity and, in consequence, cessation of the wheels' rotation. However, since the rotating energy of the wheels is an appreciable force and each wheel of the pair is running on a rail of its own both may not be out of contact at the same instant while the brake is acting, in which case the velocity of one wheel of the pair while it is out of contact with its rail may not be materially reduced by the brake action on account of the torsional transmission of rotative power from its mate, and of its own rotating energy. This would seem often to be the reason for freedom from slid-flat wheels in warm weather when track surface alignment is usually at its best.

During cold weather contraction of rails increases the joint spacing, and frost causes more or less additional unevenness in the rail surfaces; so that an emergency application or even a heavy service application made at high speed is very likely to cause injurious wheel sliding, flattening the wheels sufficiently to require their removal; not, of course, because the flats are long enough to cause dangerously severe rail punishment, but because of the annoying effect which the incessant pounding produces.

Comparing Figs. 5 and 6, which represent the clasp and the single shoe types of truck brake rigging, and by

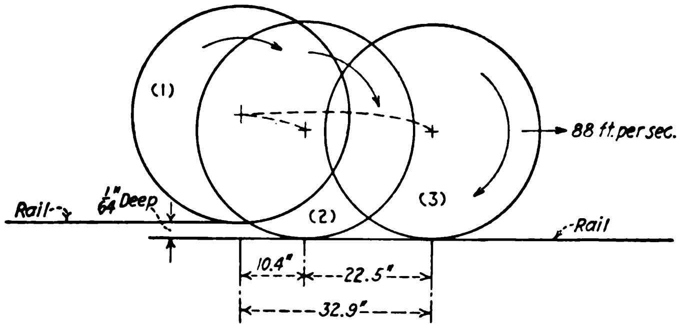


Fig. 7

(1) Wheel rolling into rail depression 1/64 in. deep.
(2) Distance of non-rail contact when equalizer spring is active, as shown in Fig. 4.
(3) Distance of non-rail contact when equalizer spring is held compressed solid, as shown in Fig. 5.

noting carefully the location of the brake shoes with respect to the wheel centers it can easily be seen that the vertical resultant of the shoe pressure, the relative magnitude of which is indicated by the length of the vectors A, is much smaller with the clasp than with the single shoe type; consequently, the clasp type will produce much less compressing effect on the truck equalizing springs than will the single shoe type; hence the clasp brake will maintain a more continuous wheel and rail contact during brake applications, and consequently there is less likelihood of injurious wheel sliding with the clasp than with the single shoe type of rigging on ordinary even surface track.

It is clear, therefore, that for the best possible continuous rail and wheel contact with any given track and wheel condition, the truck brake rigging and the brake shoes single or clasp, should be non-spring supported.

On modern freight equipment the truck brake rigging and the brake shoes are now quite generally non-spring supported, a fact which undoubtedly explains the almost entire freedom from injurious wheel sliding on freight equipment cars during brake applications made to control their speed; and if passenger and locomotive brakes were hung in a similar manner, the wheel sliding under heavy emergency applications on such equipment would be negligible, and consequently the brake efficiency could be considerably increased.

Conclusions

1—It is only for the ideal condition of rail surface with respect to evenness and for the ideal condition of wheel with respect to roundness that the coefficient of friction between the rail and the rotating wheel can be safely assumed, at speeds above the critical, to be constant in value and equal to that between the wheel and the rail when the car is motionless. Hence, all teaching respecting this point which tends to show that in practice it is, would appear to be in error.

2—Under all practical conditions of railway operation the pressure between the wheel and the rail will be variable or intermittent at all speeds above the critical, and it will vary during such speeds in quick succession between the normal maximum and zero, whether the brakes are or are not applied. If the depressions and elevations in the rail surface are of sufficient magnitude, then at high speed the non-contact rail spacing is longer than it is at low speed; hence there is a strong likelihood of wheel sliding at the higher speed during heavy brake applications.

3—If either type of truck brake rigging, single or clasp, be hung below the equalizing springs, these springs will remain as active during brake applications as they are during release; hence during brake applications the wheel and rail contact will be maintained as nearly continuous as the track condition will permit, and wheel sliding due to the brake action will be negligible with either type.

4—It being a fact that wheel sliding rarely occurs under freight equipment cars, which have the truck brake rigging non-spring supported, during brake applications made to control their speed, it is evident in connection with what has been explained in this article that a like result might be achieved for passenger equipment cars if their truck design were modified so as to provide for the non-spring support of the truck brake rigging.

5—Furthermore, the objectionable recoil of passenger trucks at the stop release of the brakes, because of the action of the brake shoe hanger in compressing the equalizing truck springs, would be eliminated, thus making for smooth stops as well as for freedom from flat wheels.

Numerous minor points which have an important influence on wheel sliding have not been touched on, but it is believed that sufficient has been said to show the important function which the truck equalizing springs and a track surface free from irregularities have to perform in efficient braking.

THE TOTAL NUMBER of locomotives, passenger coaches and freight cars built and purchased by the four groups composing the railway transportation system of Great Britain during the years 1923 and 1924, according to statistics received by the Bankers Trust Company of New York through its British Information Service, were as follows:

	Year	Built in the Companies' Shops	Purchased
Steam Locomotives....	1923	232	28
	1924	231	241
Passenger Coaches....	1923	543	29
	1924	784	71
Freight Cars	1923	17,200	4,521
	1924	26,797	6,777

The figures include a certain number of units purchased from other companies, etc., and in particular 125 locomotives purchased from the government in 1924.

Proceedings of the Fuel Association convention

Program included much of value to mechanical and operating officers—Reports of interest to former given below

A LARGE and varied attendance, which closely followed the proceedings throughout the sessions, characterized the seventeenth annual convention of the International Railway Fuel Association at the Hotel Sherman, Chicago, May 26 to 29, inclusive, as was indicated in a brief account of the meeting which appeared on page 373 of the June issue of the *Railway Mechanical Engineer*. A heavy, but well-balanced program in which was included papers and addresses of exceptional value to mechanical, operating and purchasing officers was carried through on a well-maintained schedule during the three days allotted for its completion.

The opening address of L. F. Loree, president, Delaware & Hudson appeared in last month's issue. Mr. Loree's address was followed by that of President P. E. Bast, fuel engineer, Delaware & Hudson. In the following columns will be found abstracts of Mr. Bast's address, of an address by John Purcell, assistant to vice-president, A. T. & S. F., and of several of the papers and addresses of particular interest to mechanical department officers.

President Bast's address

In reviewing the activities of this association since its inception 17 years ago, its work has been mainly of an educational character, endeavoring to present the fuel problem through its various angles to the personnel of all departments on the railroads, with a view of having them realize their responsibility in the purchase, inspection, weighing, distribution, handling, use and accounting of fuel, all of which in the end result in the greatest possible reduction in fuel costs.

We all realize the magnitude and importance of the fuel problem; it is creative work and requires initiative, ability in engineering, organization and management persistently applied. However, it is gratifying to observe that since the question of fuel conservation has been aggressively taken up by the railroads and by this and other associations, consistent progress has been made in the reduction of the amount of fuel used per unit of work in the various classes of service. In this respect we can feel justly proud of the results obtained, which reflect the excellent work on the part of management, mechanical, transportation and other departments, and all employees and others, who have contributed their share to the economical utilization of fuel. We should not lose sight of the fact that fuel conservation is an economic necessity and has far reaching direct value, not only to the railroads but to the country in general.

In this room one year ago R. H. Aishton, president of the American Railway Association, in addressing our association emphasized the importance of the saving of one pound of coal per unit of work in the combined classes of service and made us realize as never before the splendid economies that would acrue to the railroads through such saving. His address gave us a new and fuller sense of our responsibilities toward the railroads and those they serve. Our association at that time, through its officers, pledged itself to effect this saving during the ensuing year. A poster featuring this pound of coal was distributed by this association over the various railroads. The response was far beyond our expectation.

I estimate that 77 per cent of the fuel used is in freight and passenger service. Applying the known ratio of saving in these services to switch and miscellaneous service the total savings in all classes of service from efficiency alone during 1924 compared with 1923 was 10,647,000 tons, or a money value based on the average cost of fuel per ton during 1924 of $32,250,000. These


P. E. Bast (D. & H.)
president


J. W. Dodge (I. C.)
vice-president


E E. Chapman (A. T. & S. F.)
vice-president


W. J. Tapp (D. & R. G. W.)
vice-president

splendid savings are based on increased efficiency and only tell part of the story, since the major savings of the railway fuel bill were accomplished through reduction in price. For instance, in 1924 the railroads saved a total of over $93,000,000, of which 65 per cent was due to price. During the first two months of 1925 compared with the first two months of 1924 the railroads are showing a further saving in about the same ratio. Unless the economic conditions of the bituminous coal industry improve, I am concerned whether or not the railways of the United States will be able to maintain the splendid savings in fuel cost which they have enjoyed during the past two years.

While we have contributed a share in the economical and efficient use of fuel, much remains to be done. Many promising opportunities await the activities of our association by advancement of information on the fuel problem, such as through the medium of illustrated bulletins, the distribution of fuel performance statistics of the various railroads, the establishment of an economical figure in fuel consumption in the various classes of service, all of which would have a stimulating effect in creating an interest that is so vital in further solving a problem of such importance as that of railway fuel.

We are living in an age of progress and advancement. It is my hope that our association will continue to advance and prosper and that in the near future conditions will permit the working out of a plan for the endowing of a scholarship annually for the benefit of worthy young men to pursue courses in engineering and combustion.

Fundamental fuel factors

By G. M. Basford
G. M. Basford Company

To produce maximum ton-miles per hour per locomotive, per unit of total cost is the task of today. This means moving more tons faster and cheaper. It means improvement of the locomotive as a power plant to the upper limit of our knowledge, experience, vision and courage and then immediate replacement of wasteful locomotives with money-making locomotive power plants.

Hauling heavier trains faster increases the speed of operation. Increasing average freight speed increases the capacity and economy of operation of the road. It defers additional tracks. It demands high horsepower which can be and must be had at lower cost. To provide high cylinder horsepower is comparatively easy. To supply enough snappy steam for continuous high cylinder power was the problem that waited for years to be solved.

Careful attention has been given to the development of capacity for starting heavy trains. Splendid results have been obtained. This has been far from mistaken policy. The work done to raise the starting end of the drawbar-pull speed curve revealed the need for and opened the way to raise correspondingly, the speed portions of the curve.

The locomotive as a whole

Study of locomotives recent and less recent, indicates no lack of engine horsepower, but a real deficiency in steam making power, compelling wastefully high rates of combustion. Resort to double heading frequently comes from the need for two grate areas rather than two sets of cylinders. We face again the same problem that we faced 30 years ago. Then power at speeds was had at the expense of high rates of combustion and at best was limited by grate areas. This brought wider fireboxes. Heavy back ends of boilers brought the trailer truck. Rates of combustion are again excessive. Greater power at speeds is needed and additional weight accompanying larger grates must be divided between two trailer axles. The four-wheel trailer unit was developed by combustion engineers to remove the limit to further locomotive furnace progress, which means the limit to further locomotive progress.

It is fortunate for fuel conservation that more thought is concentrated on improvements in locomotives as complete units than ever before. A change has come. Standards have been raised. Lima Locomotive Works has produced startling results in its development of the 2-8-4 type. The American Locomotive Company has brought forward the three cylinder principle. The Baldwin Locomotive Works is engaging its great resources in locomotive improvement, including development of the Diesel locomotive. J. E. Muhlfeld has worked out high boiler pressure combined with compound cylinders and the water tube firebox. One of our great railroads is operating 600 locomotives with marked fuel economy by aid of limited full gear cut-off.

Single factors for fuel efficiency are numerous and very important. Space permits only brief comment on some of these elements for co-ordinated design for high power with fuel conservation.

Steam making improvements

High steam pressures promise great economies. Pressures of 250 and 350 lb. are used successfully with promise of higher pressures as water tube fireboxes develop.

Low rates of combustion are necessary. Rates on big engines today run to 150 lb. and over. This is wasteful and calls for larger grate areas to reduce this figure one-half.

Higher superheat means greater economy. It reduces the work of the boiler by improving the economy of the cylinders. Superheated steam for auxiliaries greatly reduces the drain on the fire. This economy is equivalent to increasing boiler capacity about four per cent.

Gas velocities are high. It is important to reduce them by increasing gas areas through the flues as much as fixed limits permit.

Air admission to ash pans needs careful attention. A firebox is often filled with gas over six times per second. Restriction must be avoided and spark loss must be reduced. Ash pans need about a cubic foot of capacity per square foot of grate area. Only one engine with adequate grate area now provides it.

Steam separators to remove moisture from the steam on its way to the superheater merit attention for the sake of economy. As boilers grow larger it is difficult to provide steam space for the enormously increasing volumes of steam used. It is correspondingly important to relieve the superheater of double duty, evaporating water that goes over and also superheating the steam.

The possibilities of pulverized coal as a conservation factor should not be overlooked. The use of lignite and other low grade and low cost fuels is a promising field for further development.

Steam using or cylinder improvements

Expansive use of steam in freight service may be provided by design that limits the full gear cut off. This not only saves fuel at low speeds; it results in significant increase of capacity at higher speeds. It does not involve any mechanical complication whatever. It provides additional tractive force at low speeds because it smooths out the torque curve in starting.

"Cut-off" in locomotive operation requires more attention by fuel officers than it has ever received. There is a correct, economical cut-off for every different speed of the engine, one that develops maximum power for minimum

steam at every different speed. Until recently this has been left to guess work on the part of the engineman and no two men will adjust the cut-off over a division in the same way. Perfection of power reverse gear mechanism has opened the way to large savings in properly taking advantage of steam expansion as an economy and power increasing factor. But it is necessary to indicate to the engineman the proper adjustment to be made. Cut-off adjustments have also been made automatically, controlled by the back pressure.

Trailing wheels temporarily used as tractors in starting and in helping over hard pulls reduce fuel cost per unit of work done. This principle aids greatly at the low speed end of the drawbar pull-speed curve, and in facilitating acceleration. It permits of greatly increasing ton miles per train hour by increasing operating speed. It reduces the length of time an engine (without limited cut-off) must be "full stroked" in starting and helps every engine in accelerating. It is a capacity increaser and a fuel conserver.

Machinery improvements

Many locomotive parts are unnecessarily heavy. Cast steel cylinders saved two tons in the Lima 2-8-4 type engine. Unnecessary weight restricts the weight of the boiler and robs it of some of its capacity. Weight saved in reciprocating parts reduces dynamic augment and opens the way for greater static weights on drivers.

Between lubrication and fuel there is an important relation. It is estimated that the difference in fuel required to haul a freight train of 60 cars over a division at usual freight train speeds with high grade and lower grade oil is as great as 200 lb. of coal per hour.

With the designers of locomotive power plants ready in all respects, there is no real reason why a freight engine should not be coupled to a train, haul it 1,000 miles or more, uncouple, spend 24 hours in the hands of good men who are fully supplied with facilities, return for 1,000 miles, ready to do it over again and over again. For years the Rhodesian Railway in Africa has operated freight engines 700 continuous miles with sleeping and cooking facilities in special cabooses for the crews. Their trains are slow. It should be easier for us to make long freight runs.

Of very great importance is the switch engine policy of the road. This subject merits a thorough discussion of its own. It is a combined question of machinery and of operation, both sides of it affecting lots of fuel. On a busy, congested road switch engine mileage may be as great as 25 per cent of total locomotive mileage. This suggests the best of fuel conservation attention applied to switching engines. It is financially foolish to use old road engines for switching service. Railroads perpetuating this practice have no license to urge their men to save fuel.

Operating improvements

Fuel officers are in position to aid greatly in the substitution of train direction by signal indication and in the abolition of the time killing train order, especially the "31" order that stops a train in order to tell it to proceed, also the "19" order that slows the train down for the same purpose. A slow down to a speed of 8 to 10 miles per hour is nearly as costly as a stop. Both of these orders must give place to operation by signal indication.

Fuel officers and division superintendents, signal officers and train dispatchers will profit greatly by the closest co-operation to reduce losses in getting trains over the road. Long locomotive runs, main trackers, the "peg" and "turn around" plans, are playing a big part in fuel records. The load rating of locomotives offers another and too often neglected field for fuel conservation. Distribution of power offers still another. The distribution question is greatly simplified in the case of locomotives capable of hauling with economy a wide range of traffic.

Water purification is distinctly an aid in operation. It is obviously important to provide proper water for power plants of any kind, particularly those intrusted with the handling of money making traffic. One of the railroads leading in long locomotive runs has given unusual attention to this water problem and has found it possible to reduce by 25 per cent the number of locomotives assigned to traffic involving long runs. It is reported that the largest investment involved in its long runs, is in facilities for improving its waters. The annual saving effected amounts to approximately 75 per cent on the total investment in those facilities. In the matter of increased firebox life the service of its fireboxes has been doubled in less than ten years.

Knowledge of what we are doing

Lack of definite knowledge of the operating possibilities of improved locomotives has done more than any other one thing to retard the progress of the locomotive and the improvement of the locomotive power plant. To be efficient, transportation demands test plant tests for engineering data as the basis of locomotive design and complete road tests for operating data as the basis for financially profitable locomotive operation. The American Railway Association needs a test plant. Every railroad of even fair size needs a dynamometer car more than it needs any other factor in operation. Locomotives have improved not because of exact road operating performance records and facts, but in spite of a lack of them.

Co-operation

Real fuel conservation will be accomplished when and where there is real co-operation, when a very high official compels it. An officer, in position to do so, will ask: "Is our locomotive policy right, our car policy, our maintenance, our yards, our locomotive terminals, our side tracks, our signals and our operation?" Every one of these affects every other one and every one affects fuel. They can be best answered affirmatively by co-operative concentration on one thing—Fuel.

Discussion

In presenting his paper Mr. Basford referred to the performance of the 2-8-4 type locomotive recently built by the Lima Locomotive Works, Inc., and now in service on the Boston & Albany. This locomotive, he said, had recently handled a train of over 9,000 tons in 124 four cars over a 134-mile division with comparatively level grades, except for two pusher grades at an average speed of 18 miles an hour. This run was made with an average rate of combustion of less than 60 lb. of coal per square foot of grate per hour and with an average evaporation of over 8 lb. of water per lb. of coal as fired.

A. W. Perley (O.-W. R.R. & N.) in speaking of the improvement in fuel consumption to be obtained from modern locomotives and other economy devices said that he did not question their value but that the financial problems involved were serious and could not be overlooked. He cited the case of some of the Northwestern railroads where 98½ per cent of all money raised for capital expenditures during recent years had been by the issuance of bonds. Harrington Emerson was inclined to disagree with Mr. Basford's statement that gas velocities are too high. He called attention to the scouring effect of the gases at high speeds which maintains the heating surfaces in a more effective condition for heat transfer than would be the case were the gases to travel at low velocities. He raised the question as to why smaller and thinner tubes

could not be developed with the prospect of more efficient heat transfer.

A. Lipetz (American Locomotive Company) agreed with the principles set down by Mr. Basford. He said, however, that the locomotive has been so far perfected in the last 25 or 30 years that further perfection is possible only in a very small degree and that when we hear of improvements giving 25 or 30 per cent saving in fuel, the comparison is probably made with an obsolete or very imperfect locomotive. Mr. Lipetz classified the overall efficiency of the locomotive as the product of the efficiencies of the boiler, the cylinders and the transmission. He then analyzed the possibilities for improvements in each of these separate efficiencies. He placed normal boiler efficiency of modern locomotives at from 70 to 78 per cent where coal is burned and around 80 per cent where oil is the fuel used, and expressed the opinion that efficiencies much higher than 75 per cent in coal-burning service and 80 per cent in oil-burning service were not likely to be reached, this referring to the internal processes of the boiler itself and not to the possibilities such as that offered by feedwater heating which may be as high as 14 per cent through the reclamation of waste heat. Going to the cylinders, he placed the efficiency of the engine at about 10 per cent, non-condensing, stating that with saturated steam the highest possible efficiency, according to Rankine's cycle, is 15.5 per cent at 30-per cent cut-off; 12.7 per cent at 50-per cent cut-off, and 10.3 per cent at 70-per cent cut-off, which would be slightly higher for superheated steam. On this basis he expressed the opinion that the highest efficiency of the cylinders likely to be obtained with all possible improvements would not be more than 12 per cent with the present reciprocating non-condensing engine. As to the efficiency of transmission, this, he said, is already about 95 per cent, which offers little possibility for further improvement, and his conclusion was that the possible overall efficiency would not exceed 10 per cent, which is a small increase over the efficiencies of locomotives already built of between 8 and 9 per cent.

The important principles through which this improvement may be made, according to Mr. Lipetz, are to keep the cut-off low, to have as uniform draft as possible and the combustion rate as low as possible, the latter requiring the use of large grate areas which practically must be limited to a compromise between the possibilities for economy in operation and the possibilities of high stand-by losses when the engine is not working.

Mr. Lipetz then referred to the Russian Decapod locomotives built during the European war, about 200 of which were placed in operation on various American railroads. These locomotives, he said, employ exactly the features advocated by Mr. Basford, the cylinders being large so that running cut-off would not usually exceed 30 per cent and the engines would slip at a little over 50 per cent, which automatically limited the cut-off to 50 per cent without any actual mechanical limitations. The grate area of 64 sq. ft., he said, was large in proportion to the size of the boiler, although these locomotives were designed for slow speeds on light rails and were, therefore, not mechanically adapted to the heavy service conditions of American railroads. Because of the proportions referred to, however, he said that they have been found to be exceptionally economical in the use of fuel.

Considering the fact that the modern American locomotive has already closely approached the allowable clearance limitations, Mr. Lipetz raised the question as to how the larger cylinders required by the limited cut-off principle were to be incorporated and also how the maximum uniformity of draft so desirable is to be obtained. He expressed the opinion that the three-cylinder locomotive with its cylinder volume divided and its softer and more frequent draft impulses offered the best opportunity to meet these requirements and that, furthermore, the desirability of decreasing dynamic augment is also satisfied by this type.

How can a mechanical officer effect fuel economy?

By John Purcell

Assistant to Vice-President, Atchison, Topeka & Santa Fe

The cost of fuel has more than doubled in the past ten years and has reached a point where it is the greatest item of expense next to wages. The chief mechanical officer is responsible for maintaining the locomotives in an efficient condition at a minimum cost, and with the increased cost of fuel, certain features that have to do with locomotive maintenance effecting fuel economy will require particular attention.

For many years the mechanical officer has maintained his power by doing the work reported by the enginemen and inspectors. Such appurtenances as cylinder packing, valve rings, superheater unit, steam pipe and nozzle stand joints, grates, smoke box air leaks and stopped up flues were not given attention unless the locomotive was reported as not performing properly. The waste of fuel that takes place between the time a locomotive is in first-class condition and the time it is reported not steaming is of considerable consequence. This has resulted in many roads resorting to a monthly inspection of these features in order to reduce the fuel consumption. This inspection and the necessary repairs are usually handled at the time of monthly boiler inspection and, in addition to the fuel saving, this inspection results in decreasing the number of engine failures and in the locomotives giving better service on the road.

Two problems of the mechanical officer

The average life of a locomotive has been approximately 30 years of service, and on some territories the modern locomotive consumes $30,000 worth of fuel per year, or $900,000 worth of fuel in the life of the locomotive. From the trend of fuel costs in previous years, it can be expected that the cost will continue to increase. The chief mechanical officer is confronted with two important problems dealing with fuel conservation, one being to make existing locomotives more efficient, the other to design locomotives which will render efficient service on the territories where the locomotives are to operate.

There is a field for reducing the fuel consumption of existing locomotives by the application of superheaters, feed water heaters, brick arches, increasing steam pressure, improved front end arrangements, elimination of smoke box air leaks, closer fitting grates, and by application of larger tenders which will reduce the number of stops on the road and eliminate taking water at some of the bad water points on the division. These features may be taken care of with a relatively low capital investment and should be given thorough consideration. The useful life of existing locomotives may be prolonged by these additions and betterments, making them useful and efficient units of increased capacity. The service that existing locomotives are to perform in future years should be studied, and where the capital is available, locomotives should be equipped with fuel saving devices of proved merit which will give a net saving for the application. Complications on account of weight distribution on some of the existing locomotives will be found a limiting factor.

The application of devices on new locomotives is less complicated. The locomotives being built each year secure a greater efficiency in the use of fuel. The thermal efficiency of locomotives built in 1900 was approximately five per cent, while locomotives are being built today that have a thermal efficiency of eight per cent. These per cents were secured from test plant results and show an increase in efficiency of 60 per cent in 25 years. Definite progress is being made to reduce the fuel consumption of the locomotive, and developments may be expected in the future that will further improve its efficiency. Experimental work is being done to reduce fuel consumption by use of water tube type of fireboxes, steam pressure as high as 350 lb., three-cylinder construction, 50 per cent cut-off, and the Diesel locomotive.

The need for reliable tests

Any fuel saving or capacity increasing device will make the locomotives more complicated and increase the cost of maintenance, which must be offset by an increase in the economic value of the locomotive. The chief mechanical officer is confronted by claims of low maintenance and high fuel saving for different devices that are startling. Many railroads do not have equipment accurately to test out these devices, with the result that reports of tests are being furnished which are not representative of the net saving that can be realized from the different applications. The American Railway Association is investigating the advisability of having a centralized testing plant for securing accurate and unbiased results for the member roads. Such a plan will be of great assistance to roads not provided with test equipment and organization for handling test work, and will have a far reaching effect in reducing fuel consumption.

Proper maintenance and operation are necessary to secure the greatest net saving on investment from fuel saving or labor saving devices on locomotives. The purpose of these devices is to reduce fuel consumption and without proper maintenance and operation this purpose can be entirely defeated and may result in a fuel loss.

The assignment of power suitable for the service to be performed is an important factor in fuel economy, and is equally important in cost of maintaining locomotives. The grades, average speed, character of business both present and future, quantity of fuel and the available boiler feed water must be considered. A thorough study of these conditions and careful methods of arriving at tonnage ratings of new as well as old locomotives is necessary to assign power intelligently to produce a minimum fuel consumption per unit of work.

A uniform quality of fuel should be furnished over the entire territory to which the locomotive is assigned. Tests should be made to determine the relative consumption per unit of work for each different fuel that is available. The best fuel from the standpoint of consumption and cost should be used. A good quality and grade of fuel is desirable but is not as essential as having a uniform quality of fuel. Good results are being secured from inferior qualities of fuel where it is uniform and the locomotives drafted for that particular fuel.

Better locomotive utilization saves fuel

The utilization of locomotives has been materially increased in the last ten years by the general pooling of power, and in more recent years by extending locomotive runs. It is questionable whether the pooling of power resulted in any fuel saving, but the extended locomotive run over several operating districts, or the quick turnaround on single operating districts without knocking the fire has resulted in fuel saving as well as decrease in maintenance cost. The limiting factors on how far the locomotive can run before requiring roundhouse attention are the design of locomotive, quality of fuel, quality of boiler feed water, character of business and facilities for maintaining the locomotives. It has been found economical and practical to run passenger locomotives from ten to twelve hundred miles without roundhouse attention by having turn-around attention at the end of half of this mileage. Locomotives in through freight service are being operated for distances from three to five hundred miles without roundhouse attention, with an equal measure of economy. This operation eliminates the fuel consumed at intermediate terminals and greatly reduces boiler maintenance costs on account of relieving the boiler of the severe strain caused by expansion and contraction in cooling down and firing up.

While the chief mechanical officer can assist materially in the conservation of fuel by keeping his locomotives in first class condition, the enginemen and firemen can also assist very materially in reducing fuel consumption. I had an opportunity sometime ago to review the performance of 18 passenger locomotives of the same type and size, running in pool service and handling the different trains on a 200-mile division. The report shows the performance of each individual engineman and fireman, as well as each locomotive. The amount of fuel consumed varied, on the same locomotive and same train making the same number of stops, under the same weather conditions, as much as 15 per cent. The best performance was accomplished by the proper operation of the throttle and reverse lever; also lubrication, good firing practices, avoiding waste of steam through pops, and the height the water was carried in the boiler.

It is possible for the best maintained locomotive and the best trained engine crew to show a poor fuel performance if the train is not moved at an economical speed, or if the train furnished by the transportation department does not utilize the capacity of the locomotive. These transportation features are as important in fuel conservation as the design, maintenance, assignment or efficient operation of locomotives, which are the direct duties of the mechanical officer.

Report on boiler feed water heaters

The committee is able to report a very substantial gain in the number of feed water heaters applied and on order as of May 1, compared with previous years as follows:

Year	Feed water heaters	Exhaust steam injectors
1920	7	..
1921	54	..
1922	234	..
1923	1,429	..
1924	2,123	24
1925	2,551	37

This remarkable gain in the past few years is conclusive of the practicability of the feed water heater.

Closed type feed water heater

Since the last report of this committee, important developments for the closed type feed water heater equipment have been three in number as follows:

1—Development of a duplex feed pump of smaller size, but larger capacity and smoother action compared to the original simplex type.

2—Perfection of means for preventing accumulation of scale in the heater.

3—Protection of the heater equipment against any possible corrosion, electrolysis or action of acid used in washing.

The new type of boiler feed pump developed by the Superheater Company with the Elesco closed type feed

water heater is known as the constant flow type. This is of the duplex arrangement wherein steam distribution is so arranged that the movement of the two pistons is the same as if they were connected to cranks set at 90 deg. angles so that with one piston at the end of the stroke, the other is at that instant at mid-stroke, thereby insuring that when one piston is reversing the other is delivering a steady stream of water. Thus a steady regular flow of water is produced, which insures keeping the boiler check off its seat while the pump is in operation.

This pump is capable of discharging 10,000 gallons of water an hour against a pressure of 225 lb. There are now over 300 pumps of this design in service and it has been adopted as standard equipment for the larger sizes of Elesco feed water heaters.

Brief mention was made in the discussion of last year's report to the effect that methods were being developed which would prevent accumulation of scale in the tubes of the closed type feed water heater in bad water districts. It was explained at the time that this process consisted in the addition of a very small amount of a compound to the water in the tender, which acted as a protective colloid and would prevent the precipitation of scale out of the feed water until after it had passed through the heater. The compound used for this purpose is chestnut bark extract, a product commonly used by tanners. This is fed into the water in the tender in proportion of one part extract to about 100,000 parts of water. Tests have shown that some antifoaming compound regularly fed produces the same results.

Experiments have been carried on during the past year in the district where the largest amount of scale accumulated in the tubes of the feed water heaters. It has been found that it is possible to run heaters continuously in that district without cleaning, and without accumulation of any scale or other deposits in the heater tubes. Inasmuch as the most satisfactory results are obtained when the compound is added to the water in the proper proportions, a mechanism has been developed which will automatically measure and feed the compound whenever water is taken. It will normally cost about ¼ cent per 1,000 gallons for treating the water in this way, after the apparatus is applied. It is only recommended that the anti-scale treatment be used in cases where the heater requires washing each 30 days or less.

In certain districts some trouble has been encountered from corrosion from acid washing and electrolysis of feed water heaters, due to some unusual condition in the feed water. In order to prevent all troubles of this nature arrangements are now made to cover all steel or iron parts of the Elesco feed water heater that are touched by water, with a non-corrosive coating. It is the intention of the manufacturers to protect all feed water heaters in this way.

Open type feed water heaters

There have been purchased to date, by the railroads of the North American continent, slightly more than 1,400 open type feed water heaters. Operation of these units has gradually improved through the growing familiarity of the users with the construction and functioning of the apparatus, with the development of organized maintenance and with gradual improvement in materials and construction. The latter have included steps looking to the perfection of the steam valve gear and the water valve service and the selection of suitable materials for gaskets and pump piston and piston rod packings.

The Pennsylvania Railroad has released information concerning tests made on the locomotive testing plant of open type feed water heaters applied to their Decapods or 2-10-0 type locomotives in which they show that within the capacity of the feed water heater they credit a saving of 14 per cent as an average throughout its complete range. This is somewhat higher than has been previously reported by your committee, but this range could well be made with a coal burning locomotive where the coal rate per square foot of grate area is high and consequently reduces the boiler efficiency.

Cleaning of the open type heater, where necessary at all, and in all but the most exceptional cases, can be deferred to the general shopping date. Methods of cleaning, thus far resorted to, consist of scraping, washing, and the judicious use of the scale solvents on removable parts. Fully half of the installations thus far made are characterized by the omission of the oil separator from the exhaust steam line to the heater, this having been done at the option of the users, thus far, with no results that prompt them to question the correctness of this line of procedure.

Scale formation in the heater is confined mostly to the upper section of the heater, where, between shoppings, scale will form to a thickness of between one and two inches. In the lower sections of the heater, the formation of scale is not noticeable. These scale formations in the heater, however, do not affect the working or the temperature of the water delivered. Another troublesome scale formation is found in the atmosphere vent pipe from the heater, which has, at times, been entirely closed by scale, and when in this condition it reduces the temperature of the feed water as much as 15 or 20 deg. on account of the inability to get rid of the air in the heater.

Exhaust steam injectors

In the 1923 and 1924 reports of this committee, brief mention was made of the exhaust steam injector, and attention was drawn to some of its more prominent characteristics. The development of this apparatus to meet American conditions has progressed steadily during the last three years. The principal attention has been given to the perfection of an automatic control arrangement, making unnecessary the manipulation of a number of levers and valves for the proper operation of the instrument. Many of the older types have now been changed and all new ones furnished are equipped with the new control.

As now arranged the operation of this injector is simple and requires little attention on the part of the engineman. To obtain the most economical results it should be operated by adjusting the water regulator so as to meet the demands with the use of as little supplementary steam as possible. The amount of this supplementary live steam when the locomotive is in operation depends largely on the exhaust steam pressure and the temperature of the feed water. The injector has been known to work perfectly against 200 lb. boiler pressure with the supplementary steam shut off entirely when the back pressure was about 4 lb. and the feed water temperature was 45 deg. F. Injectors will handle feed water successfully up to 85 deg. F. temperature.

It is very important that the size of the injector be suited to the size and power of the locomotive.

Some figures are now available in connection with the cost of maintenance of the exhaust injectors. One road reports that the cost of maintenance for twelve months, from April 1, 1924, to April 1, 1925, on eleven injectors amounted to a total of $490. Of this amount $265 was for material and $225 for labor. This amounts to about $45 per injector per year, or $1.20 per 1,000 miles. These eleven engines made a total of 407,245 miles during this period.

The following quotations were selected as typical from various reports received by the committee:

"This device has given us about 5½ per cent reduction in water consumption with a proportionate saving in fuel since its installation in July, 1923. It is my opinion that when the mechanical imperfections we have found in the injector have been eliminated, it will show a saving of between 10 and 11 per cent in fuel."—Report dated April 5, 1925.

"Our experiences with this injector have been so satisfactory that we anticipate a considerable extension in the use of this device. Results of road tests made with very meagre test apparatus showed the exhaust steam injector to save about 7 per cent when compared with a non-lifting live steam injector."—Report dated April 10, 1925.

Inasmuch as such test data now available does not point to any definite conclusions the committee hesitates to give a general statement as to the savings which may be expected of the exhaust steam injector. The lack of determinate data can in part be attributed to the number of variable factors involved such as the use of both exhaust and live steam and to variations in efficiency which may occur at the various rates at which the exhaust injector is operated. It is established, however, that there will be a noticeable drop in back pressure and that the superheat will be lowered about 15 deg.

Feed water purifier

The Canadian National was experimenting with one locomotive equipped with a feed water purifier placed on top of the boiler so that the discharge from the feed water heater and injectors passed through it to the boiler but so much trouble was experienced that it was removed and within the knowledge of the committee there are at this time none in service in this country. This device is particularly applicable to waters which contain a great amount of carbonates and feel that this is a subject that should not be dropped by the American railways.

Feed water heating at terminals

Last year the committee referred to the fact, that approximately 20 per cent of all locomotive fuel is consumed at terminals, and presented some figures to show the effect on fuel consumption of supplying hot filling water for locomotives, where the filling water is heated by blown off water and steam that would otherwise be wasted. It was estimated that the possible fuel saving from this source amounted to from 1,500 to 2,000 pounds of coal for each locomotive filled.

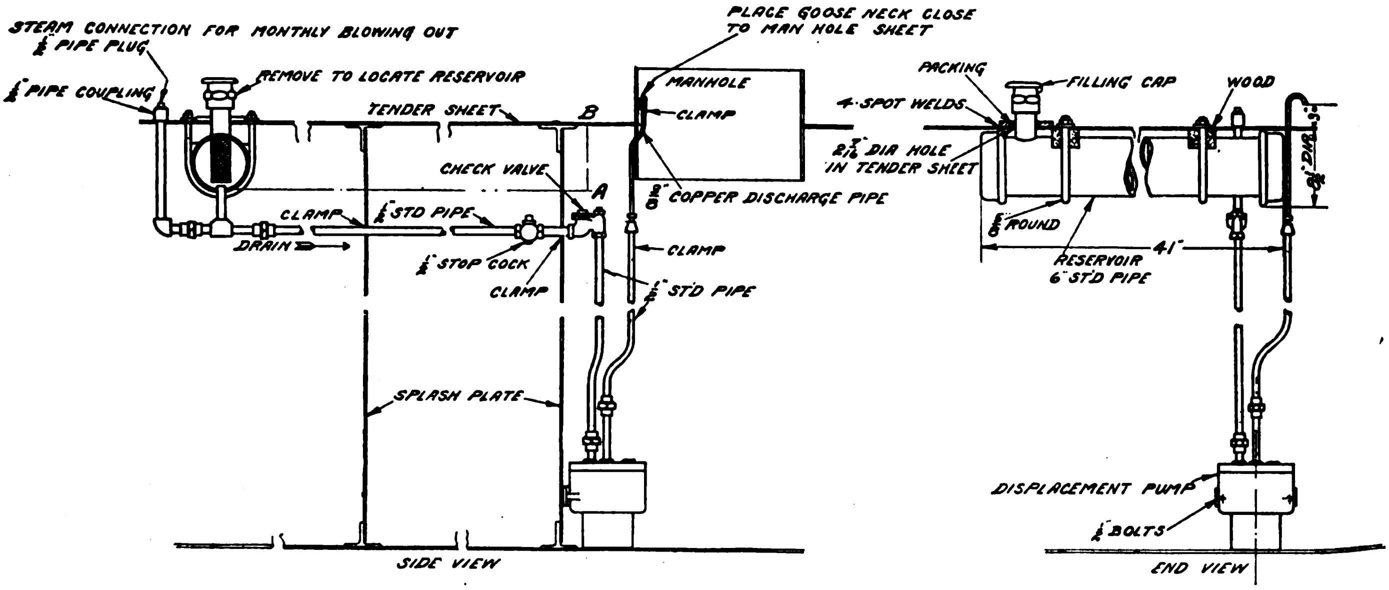
One of the factors in connection with the savings from boiler feed water heating at terminals is found in the reduction of steam blower consumption, resulting from the reduction in time required for firing up locomotives filled with hot water over the time required to fire up a locomotive filled with cold water. The test which will be described in more detail in subsequent paragraphs indicated that this saving in time amounted to about five minutes in the time required to steam up a locomotive for each 10 deg. increase in the temperature at which the boiler was filled. On this basis, it will require about one hour less to steam up a locomotive filled with water at 180 deg. F. than the time required to steam up a locomotive filled with water at 60 deg. F.

As the saving in blower steam consumption resulting from a reduction in the time required to steam up a locomotive depends upon the rate of steam consumption of the blower itself, the committee further undertook to investigate the situation with respect to the quantity of steam required for blower purposes. It is apparent from the replies received, that this phase of locomotive terminal operation has received very little consideration, and that the quantity of live steam ordinarily required for firing up locomotives represents a greater fuel loss than is generally appreciated. While no general conclusion as to steam consumption required for blower purposes can be drawn from the above, it is evident that the blower is a fuel consumer of sufficient magnitude to warrant careful attention.

In this connection some very interesting information was submitted by the Baltimore & Ohio on the use of a motor driven induced draft fan for steaming up locomotives. The following table shows the results of some tests comparing steam blower operation and an electrically operated fan.

These figures show up the cost of operating a steam jet in a very forceful manner. For practically the same conditions throughout, the fan was able to fire up a locomotive for a cost of about 3.7 per cent of the cost when using the steam blower.

The latest important development in connection with boiler feed water heating at locomotive terminals is the direct injection into the locomotive boiler of live steam



Measuring apparatus for automatically supplying cleaning compound to a locomotive feed water heater

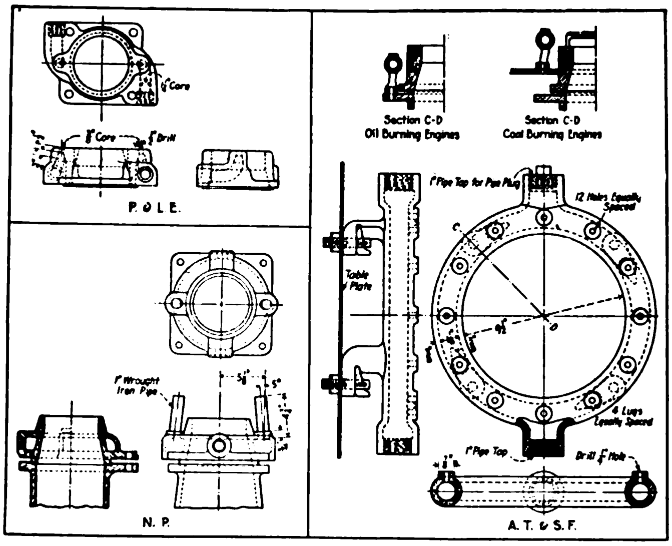
together with hot filling water for the purpose of reducing the time and fuel required to steam up locomotives. This method may also be utilized for steaming up locomotives to a working pressure without lighting the fire, for the purpose of eliminating smoke and blower steam in the engine house. In addition to the economy to be gained from filling with hot water, the direct injection of live steam generated in an efficient stationary boiler requires less fuel than the same amount of steam generated in the locomotive firebox during the firing up period. The reduction in blower steam required with this method represents a further fuel saving.

Data relating to electric blowers for firing up locomotives in enginehouses

Abstract from tests conducted September 26, 1923, on a Mikado locomotive:

Items	Fan	Steam blower	Difference
Kind of coal used	R.m. gas	R.m. gas	....
Kind of kindling used	Fuel oil	Fuel oil	....
Average temperature of water at start, deg. F.	72	76	4
Pounds of coal on grates at start	1,212	1,206	6
Pounds of coal fired during test	690	681	9
Total coal used, pounds	1,902	1,887	15
Draft in smoke box, average, in	0.84	0.81	0.03
Kw. hours used	4.03	......	....
Pressure on steam blower line, lb. per sq. in.	....	85.5	....
Pounds steam used per hour	....	2,452	....
Pounds of steam needed to draft locomotive	....	2,800	....
Area of blower nozzle tip, sq. in	....	0.87	....
Time to get 1 lb. per sq. in. steam pressure after light-off, min	43.0	47.0	4.0
Time to get 65 lb. per sq. in. steam pressure after light-off, min	66.5	68.0	1.5
Cost to draft locomotive	$0.062	$1.682	$1.62
Cost per 1,000 pounds of steam	....	0.60	....
Cost of power per kw.-hr	.0154	......	....

The equipment required for direct steaming is the same as for blowing off locomotives and for washing and filling locomotives with water heated by the blown-off steam and water, with the addition of a live steam main from the power plant with connections to each filling drop. With these connections the usual procedure would be to attach the blow-off valve to the combined blow-off and filling connection as soon as the locomotive is placed in the engine house. If the boiler is to be washed or water changed, the contents are blown off through this flexible connection. When ready to fill, both the filling and live steam valves are opened. The hot filling water and live steam combine in a booster connection and enter the locomotive boiler at a temperature considerably over 212 deg. As soon as water shows in the glass, the hot water valve is closed and the flow of live steam continued until a working steam pressure is built up in the boiler.



Typical examples of locomotive blower nozzles—The P. & L. E. reports that it requires about 16 boiler hp. per hr. to operate the blower shown in steaming up locomotives—The A. T. & S. F. reports steam consumption of about 30 boiler hp. per hr. to operate the blower shown for steaming up oil burning locomotives—The N. P. reports steam consumption of 50 boiler hp. per hr., with the nozzle shown in steaming up coal burning locomotives

This practice was referred to in the previous report in connection with the subject of feed water heating at terminals and several installations of the direct steaming system are now being made at new terminals so that a study of this method in regular operation will be available for the next report. For the current report, the most comprehensive data on this subject is found in the results of a series of tests on steaming up locomotives that was conducted by the Atchison, Topeka & Santa Fe during the past year at Newton, Kansas.

The following general conclusions may be drawn from these tests:

1.—The consideration of steaming up without fire implies the use of high pressure steam in power plants and consequent changes in order to obtain the desired speed in building up the steam pressure in the boiler, requiring the use of steam pressures of about 200 lb. and stationary plants built accordingly; also a system for filling at 180 deg. F. and above.

2.—A saving of fuel would amount to slightly over one gallon of oil, or its equivalent in coal, for each thousand gallons of boiler feed water used in firing up when heated 10 deg. F. by the utilization of waste heat.

3.—There would be an average saving of time of about 4 to 5 min. for each 10 deg. F. difference of feed water temperature.

4.—A saving of time would result from the combined filling, steaming and firing up processes, of 35 min. as compared with simple firing up with 180 deg. F. initial temperature. There should be a reduction of stand-by losses together with some reduction of smoke nuisance in roundhouses. The latter would, of course, be especially noticeable in case of coal burning locomotives.

The report is signed by E. E. Chapman (A. T. & S. F.), chairman; E. A. Averill (Superheater Company), Stanley H. Bray (S. P.), A. G. Hoppe (C. M. & St. P.), V. L. Jones (N. Y., N. H. & H.), John M. Lammedee (Worthington Pump & Machinery Corporation), L. P. Michael (C. & N. W.), Geo. S. Mikles (N. Y., O. & W.), Geo. E. Murray (N. Y. C. & St. L.), L. G. Plant (National Boiler Washing Company), John M. Snodgrass (University of Illinois), and H. W. Sefton (C. C. C. & St. L.).

Discussion

Considerable interest was shown in the steaming up of locomotives at terminals by the injection of live steam directly into the boiler after it has been filled with hot water. The question was raised during the discussion as to what effect this practice would have on expansion in various parts of the boiler, which brought out the explanation that with the injection of steam into the boiler the water is heated gradually throughout the boiler and that steam rises over the entire surface without overheating any part of the boiler. On the contrary when steam is raised from cold water by firing up the locomotive, the firebox is heated to a high temperature while the rest of the boiler is still cold, thus inducing unequal expansion strains.

T. C. McBride (Worthington Pump & Machinery Corporation), said that while the practicability of the locomotive feedwater heater is considered to be established, it should not be thought that development work is not still being done, and called attention to a number of

features in the open type heater which have recently been improved. Mr. McBride also expressed the opinion that the rating of the feedwater heater in terms of per cent of saving does not mean much because the actual saving depends on the amount of work done by the locomotive. He suggested that the reduction in the number of pounds of coal per hour effected by the heater in a given class of service would convey a more accurate idea of its economic importance.

R. M. Osterman (Superheater Company) gave some information concerning the possibilities of the exhaust steam injector from a feedwater heating standpoint which have been brought to light in the development tests of this instrument. He stated that the type of Metcalf injector in use on some foreign roads has effected savings of 3 or 4 per cent as compared with savings of 9 per cent with other types of heaters. He said that the tests in this country indicate no reason why the performance of the injector should be inferior to the pump type heater. The amount of saving, he said, depends on the quality of the injector which in this country has demonstrated its ability to pump against 150 lb. boiler pressure with 1 lb. exhaust steam pressure at 60 deg. superheat. He called attention to the fact that the exhaust steam injector must be carefully proportioned in its capacity to suit the capacity of the boiler which it is to supply with water.

C. W. Sturdevant (Southern Pacific) gave an interesting account of the results obtained on the Southern Pacific by the application of the Zeolite method of water softening on the Southern Pacific. In a stationary boiler plant at Los Angeles, he said, a water is used containing 14 grains per gallon, mostly of calcium and magnesium carbonates. Before using the treatment the feedwater heater would accumulate about 2 in. of scale and the pipes became plugged so quickly that it could not be operated longer than seven to eleven days without cleaning. Since the Zeolite treatment has been in use, the heater was operated six months when, on examination, no trace of scale was found. He said that the treated water had been introduced into locomotive service at Los Angeles and that no trouble with foaming had been experienced, whereas before treatment was introduced it was necessary to use anti-foaming compound on all locomotives as well as in the power plant. In answer to questions, Mr. Sturdevant said that the Zeolite material is a natural green sand, the action of which is essentially to effect an exchange of sodium for calcium. He said that the Los Angeles water would require about 1 lb. of lime and ½ to ⅝ lb. of soda ash per 1,000 gallons, which he estimated would cost about 2¼ cents per 1,000 gallons to treat. The cost of the Zeolite, he said, was about 1¾ cents per 1,000 gallons. The calcium and magnesium removed from the water, he said, are filtered into the sand, which is reconditioned by the periodical introduction of a salt bath at the rate of approximately ½ lb. of salt per grain of hardness per 1,000 gallon of water treated. One advantage of this treatment which he mentioned is the fact that the water can be used for drinking purposes.

Mechanical means for cleaning locomotive flues

By C. B. Smith

Mechanical Engineer, Boston & Maine

The importance of clean metal on both the fire and water surfaces of boiler flues, as well as of firebox plates, needs no argument before the members of this association. The slow accumulation of encrusting solids upon the water surfaces calls for periodic cleaning not less frequently than once a month.

In extremely bad water districts additional means for scale prevention by water treatment are necessary and are practiced by different methods, depending on the chemical nature of the water. In eastern territory water taken by locomotives is usually fit for boiler purposes. Although there are occasional points where relatively bad water must be taken either on the trip or at one terminal, water treatment is not generally regarded as warranted. It is difficult, under such conditions, to show an economy from the investment for boiler compounds. In such territory the gradual accumulation of scale on the water side of boiler plates is certain to occur between class repairs, somewhat reducing the efficiency of heat transmission during the service period of the locomotive. According to Kent, "The influence of scale on heat transmission in locomotive boiler tubes" may vary from 2 to 19 per cent decrease in conductivity. Tests indicate 4 to 6 per cent as representative.

The tubes and flues provide the passage for gases from the furnace and if not kept reasonably free from the accumulation of soot, ash and clinker, to permit sufficient draft for proper combustion, a steam failure will result. Hence the importance of systematic flue cleaning, performed as frequently as the character of the coal requires.

It is not uncommon to dump locomotives for flue cleaning once each week. The cycle of operations include:

Dumping fire.
Removal of required number of firebrick—usually the center rows.
Inspection with an open-flame torch.
Labor of blowing flues and tubes, punching out solid deposits when necessary. Washing with water is also practised by some roads.
Restore firebrick, replacing broken bricks by new bricks—usually 50 per cent of new bricks are required.
Rebuild fire.
Restore steam pressure.

The time required for this cycle of operations is about three hours, including from three-quarters to one hour for cleaning the flues and tubes. In our experience the cost of labor and material involved in this operation amounts to about $30.00 a month for each locomotive.

The writer has no figures on the loss of efficiency due to dirty and plugged flues, but it is obvious that this is cumulative from the time that a locomotive goes into service with clean flues until they are blown out again. Records which have been kept on two divisions show that plugging of flues frequently amounts to 10 per cent of the flue area. This refers to flues completely stopped up, no consideration in the reports being given to flues only more or less coated with soot.

For several years past the installation and satisfactory use of mechanical flue blowers in the rear connection of horizontal return tubular boilers in stationary service has led the writer to a favorable consideration of a similar device for locomotive boilers. Such a device was brought out a few years ago. The blower consists of a movable steam nozzle mounted on each side of the boiler and projecting into the firebox at a point above the arch and at a proper distance back of the tube sheet. To operate it, the nozzle is advanced into the firebox by the movement of a lever and then rotated by a hand wheel. These controlling handles are conveniently located in the cab. The opening in the nozzle is shaped at such an angle that when it is rotated a wide, flat, jet of steam is spread over the tube sheet. When the blowing operation is concluded the nozzle is drawn back into a water space thimble to avoid its being burnt. Steam is piped from the turret or other suitable point on top of the boiler and is preferably controlled by means of a quick-opening valve easily accessible in the cab.

As far as the writer knows the first locomotives in the United States to be equipped with this blower are being operated in New England territory and, as a re-

sult of the experiment, road locomotives built about two years ago were also equipped with it. In this lot were Santa Fe type locomotives having a grate area of 80 sq. ft. and equipped with a Gaines wall and a brick arch. These locomotives have been in constant service running with older locomotives of the same type and design not equipped with flue blowers. If the blowers are operated twice on each road trip, these locomotives do not have to be dumped for flue blowing between the monthly washout periods. On duplicate locomotives not equipped with blowers, it is necessary to dump the locomotives to clean the flues every seven to nine days. At the washout periods when careful attention is given to cleaning flues and tubes, it is found that, regularly there is little cleaning needed on the Santa Fe locomotives equipped with the blowers and they can be made ready for road service more quickly than the locomotives not equipped with blowers.

The other locomotives in this lot were the Pacific type in which it is standard practice to leave an opening between the tube sheet and the brick arch to prevent plugging of the lower rows of tubes by the accumulation of ash and cinders.

The coal used on these locomotives is uniformly low in ash and sulphur, about 36 per cent volatile and 14,000 B.t.u. It has a firm structure and runs about 35 per cent, 1¼-in. slack on the tenders, costing on an average of $5 a ton. The fusibility of the ash varies from 2,650 deg. to 3,000 deg. F.

The maintenance required by this equipment over a two-year period has been found to be very slight. At the monthly boiler washout the apparatus is inspected and the operating mechanism oiled. About once in six months the stuffing box of the blower nozzle tube may need repacking. There has been little or no trouble from the burning of nozzles.

Owing to the good results already obtained with these blowers we have started a monthly program for application of the device at class repairs to a considerable number of Pacific, Consolidation and Mogul type locomotives.

Discussion

This subject aroused much interest among those in attendance. The discussion brought out the fact that the New York, New Haven & Hartford has 43 locomotives equipped with flue blowing devices, and that one of these engines ran 90 days without having the flues blown at the terminal, after which only 17 tubes were found plugged, whereas formerly it was necessary to blow the flues every 10 days. Where engines are equipped with this device, it has been possible to place the arches against the flue sheets of switch engines, thereby reducing the smoke nuisance where this is a factor of importance. In answer to questions it was stated that the fireman is the best judge of the proper locations at which to operate the flue blower. Such locations should be selected where there are few houses and if this is done there will be no complaints because of the soot blown out of the stack. In one case where the flue blower is in use, it has been found by pyrometer readings that the superheated steam temperatures run from 650 to 670 deg. F., whereas 600 deg. F. is the best that can be maintained on other engines.

Other addresses and reports

Other addresses and papers were presented during the convention on the following subjects: Signals and the saving of fuel, by B. J. Schwendt, New York Central; How can railroad management effect fuel economy, by A. R. Ayers, New York, Chicago & St. Louis; How can fuel purchases effect fuel economy, by H. C. Pearce, Chesapeake & Ohio; Stocks, production and consumption of coal, by Mark Kuehn, National Association of Purchasing Agents; The development of oil-burning practice on locomotives, by J. N. Clark, Southern Pacific, and Back pressures as an index to fuel economy, by R. W. Retterer, Cleveland, Cincinnati, Chicago & St. Louis.

The following are the committee reports other than those abstracted herein which were on the program: Report on fuel accounting, distribution and statistics; report on firing practice; report on stationary power plants; report on Diesel locomotives; report on fuel stations. Abstracts of several of these reports will appear later.

Tests of Missouri Pacific three-cylinder Mikado

High boiler and engine efficiencies shown in performance on Altoona test plant

ONE of the three-cylinder locomotives recently built by the American Locomotive Company and described in the *Railway Age,* May 16, 1925, was a Mikado (2-8-2) type for the Missouri Pacific. Before this locomotive was placed in road service it was sent to the testing plant of the Pennsylvania at Altoona, Pa., and submitted to a thorough test. The results obtained are of particular interest due to the fact that this is the first three-cylinder locomotive of which complete tests have been made.

This locomotive weighs 340,000 lb. of which 244,500 lb. is on the drivers, and has a rated tractive force at starting of 65,700 lb., this making the factor of adhesion 3.72. The two outside cylinders are 23 in. by 32 in., the inside cylinder is 23 in. by 28 in., the boiler pressure is 200 lb. and the drivers are 63 in. in diameter. The leading weights and dimensions are given in an accompanying table.

The boiler is of the straight-top type, 88 in. in inside diameter and fitted with a firebox 114⅛ in. long by 84¼ in. wide. There are 199 tubes 2¼ in. in diameter and 45 flues 5½ in. in diameter, all 19 ft. long. The superheater is a type A with 1½-in. tubes, 17 ft. 11¾ in. long. The brick arch is carried on two tubes 3 in. in diameter. The grates are of the table type and the grate area is 66.8 sq. ft. The firebox is fitted with a Nicholson thermic syphon having two water legs. In addition, the barrel of the boiler is fitted with the Harter circulator which consists of a flat horizontal plate located at or about the mid-height of the boiler, extending nearly the full length

of the tubes and provided with steam outlet pipes leading up from the plate to the steam space near the top of the boiler. Coal is fed to the boiler by an Elvin stoker.

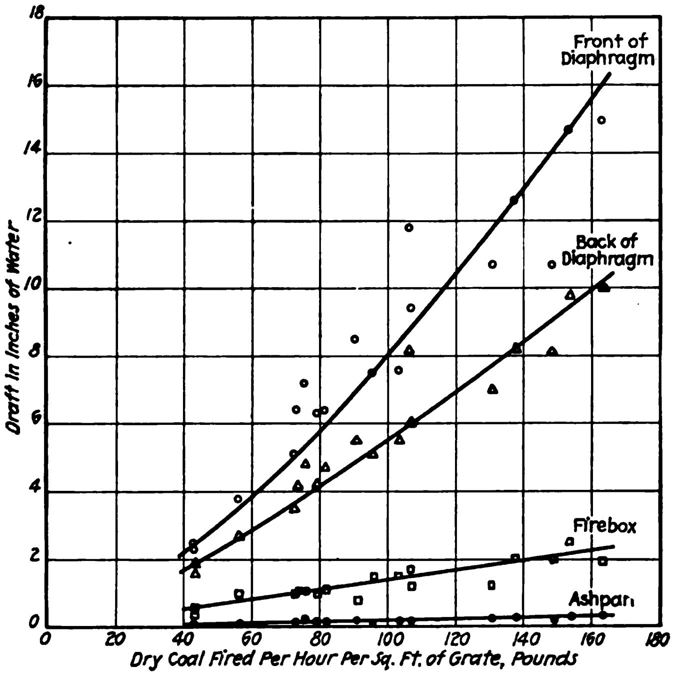


Fig. 1—Draft records for ashpan, firebox and smokebox

The heating and superheating surfaces are divided as shown in the table below:

Heating and superheating surfaces—sq. ft.

	Waterside	Fireside
Firebox, alone	268	271.3
Syphon	67	79.2
Arch tubes	14	15.5
Firebox, total	349	366
Tubes and flues	3,437	3,110
Total evaporative	3,786	3,476
Superheating	1,051	1,367
Comb. evaporative and superheating	4,837	4,843

The water space in the boiler below the second gage cock is 683 cu. ft. and the steam space above is 108 cu. ft. or 14 per cent of the total boiler volume.

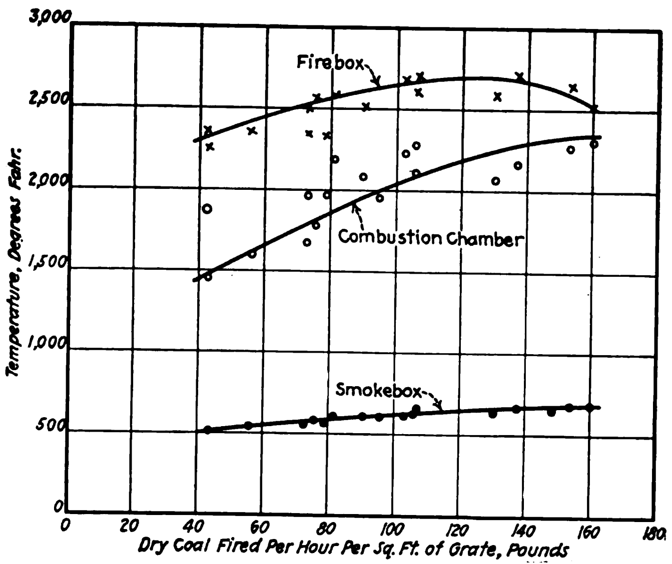


Fig. 2—Gas temperatures in firebox, combustion chamber and smokebox

The total air inlet in the firebox is 28 sq. ft., 26.9 sq. ft. being through the grate and 1.1 sq. ft. above the fire bed. The air openings through the grates constitute 41 per cent of the grate area. The net gas area of the openings through the tubes and flues is 8.5 sq. ft.

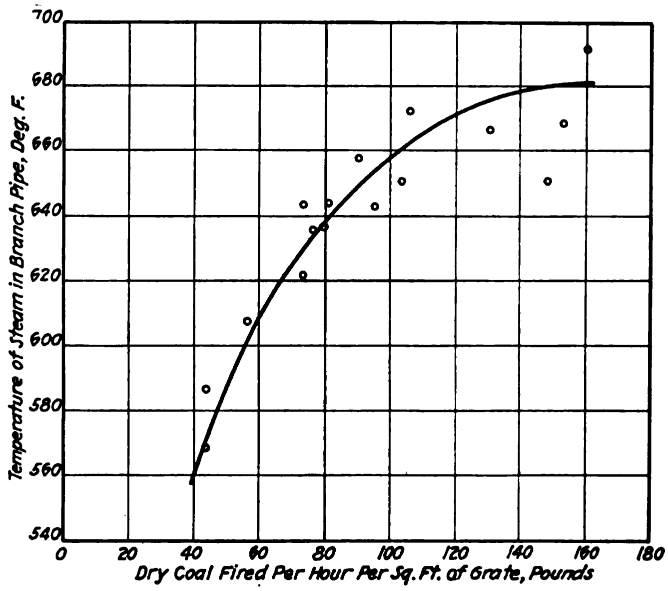


Fig. 3—Temperatures of steam in branch pipe at different rates of combustion

The area of the air inlets to the ashpan is 14.5 sq. ft. or 171 per cent of the area of the tube and flue openings.

The locomotive is equipped with the Baker valve gear

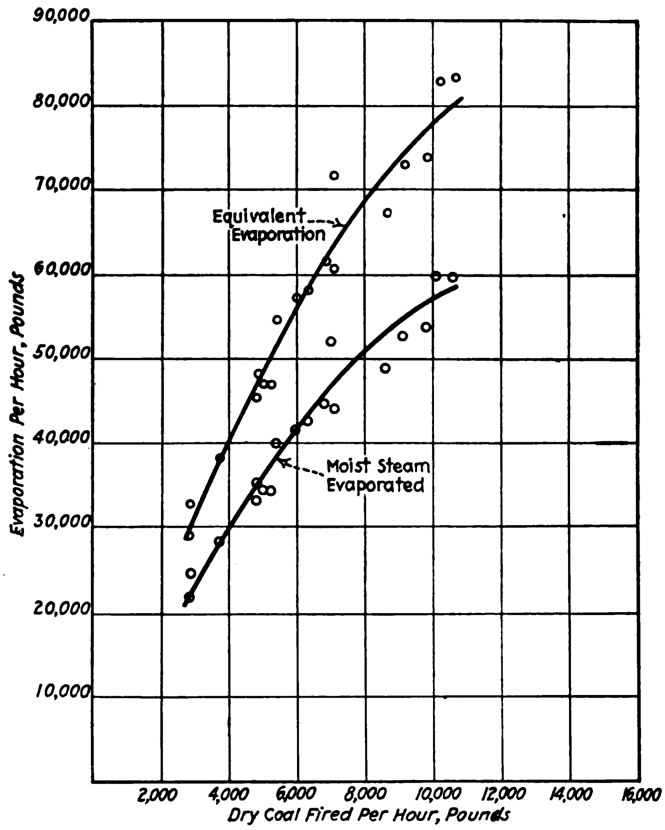


Fig. 4—Actual moist steam evaporated and equivalent evaporation at different rates of firing

and the valve for the inside cylinder is operated by the mechanism employed by the American Locomotive Company for all the three-cylinder locomotives that they have built recently. The piston valves have 6½ in. maxi-

mum travel and are laid out for 1 3/16 in. steam lap and no exhaust lap.

The coal was the same as that generally used at the test plant as a standard for freight locomotive tests and road service. It is a Pennsylvania bituminous coal from the

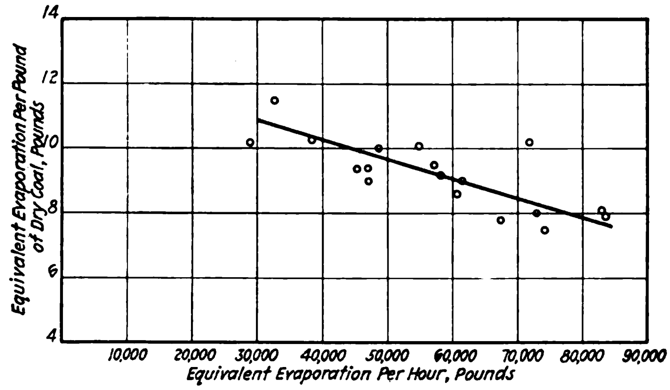


Fig. 5—Variation in equivalent evaporation per pound of dry coal according to boiler output

crows nest mine of the Keystone Coal & Coke Company near Hempfield Station on the main line of the Pennsylvania, in the Greensburg district. It is a Pittsburgh seam coal, medium hard and semi-blocky. The coal contains about 60 per cent carbon and 30 per cent volatile matter and has a calorific value of about 13,300 B.t.u. as fired It was in run of mine size, and, while about 30 per cent of it will not go through a screen having 4-in. round openings, it contains small sizes, so that three per cent of it will go through a screen having 1/16 round openings

When the tests were started, the driving axle bearings

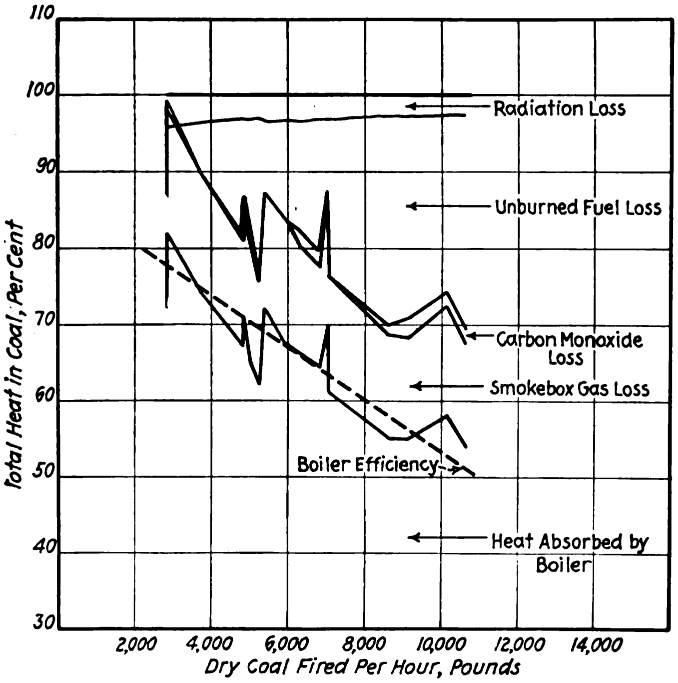


Fig. 6—Boiler efficiency and heat losses

had been run from Schenectady to Altoona but the crank pin bearings had been operated very little. The main crank pin bearings, both outside and inside, are of the floating type in which the brass is in three segments and separated from the rod by a hardened steel liner. The brass bearing is perforated so that the grease has access to both its inner and outer surfaces. On the two outside main crank pins these bearings ran hot until they been well broken in, after which they gave no trouble.

As received at the test plant, the locomotive was difficult to fire and appeared to have insufficient draft. From the similarity to the Pennsylvania Lls. (2-8-2) class it was believed that with proper combustion an evaporation as high as 59,000 lb. of water per hour, or about 12 lb. per square foot of total combined heating surface could be reached. In order to determine this by actual test, a run was made at 160 r.p.m., 50 per cent cut off, and wide

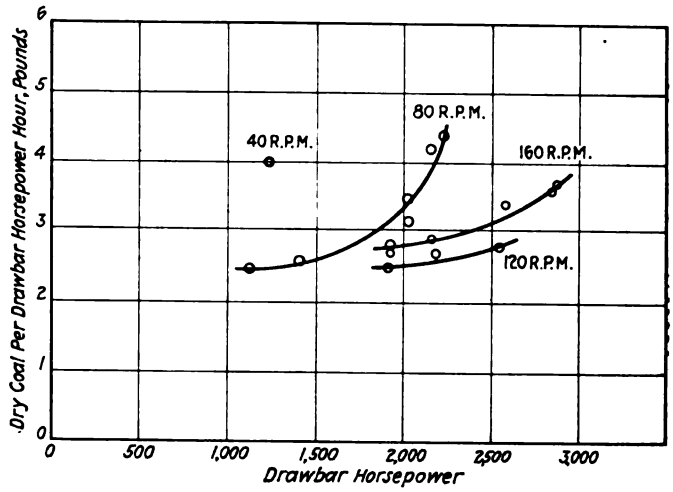


Fig. 7—Dry coal consumption per drawbar horsepower at various speeds and loads

open throttle, as soon as the locomotive had been operated on the plant enough to make such a heavy load feasible. The result was an evaporation of only 48,000 lb. per hour, or about 10 lb. per sq. ft. of total combined heating surface. The draft in the smoke box was 9 in. of water. Measurements of the velocity head of the smokebox gases at the top of the stack showed all positive pressures, and as much as 10 in. or 11 in. of water at the edges.

The stack of the locomotive has a diameter of about

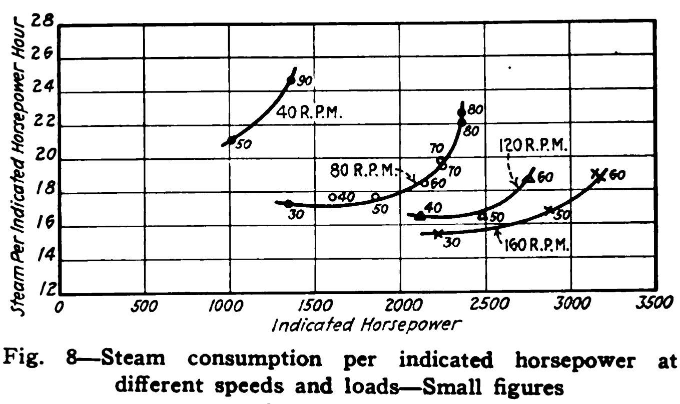


Fig. 8—Steam consumption per indicated horsepower at different speeds and loads—Small figures denote cut-offs

19 in. at the top, tapering to 18 in. near the top of the smokebox, and then tapering out to a much larger diameter at the lower end, which is about 2 ft. 5 in. above the exhaust nozzle.

For the purpose of improving the draft conditions, a basket bridge was fitted to the exhaust nozzle, the inside diameter of the tip was increased to 6½ in. and the stack was fitted with an extension the lower end of which was about 15 in. above the nozzle. Trials with this arrangement showed little improvement in the strength of the draft.

On account of the similarity of the boiler of No. 1699 to that of the Pennsylvania Lls. class, it was thought that the essential features of the Lls. front end, that is, its arrangement of stack and nozzle, might enable No. 1699 to steam properly. The Lls. stack has a diameter of 17 in. at the base and tapers uniformly to the top where the diameter is 24 in., resulting in an area at the top about 50 per cent greater than in the original stack of No. 1699. After this stack, which was found to fit the front end arrangements of this locomotive, had been applied, and with the same 6½-in. exhaust nozzle, with basket bridge,

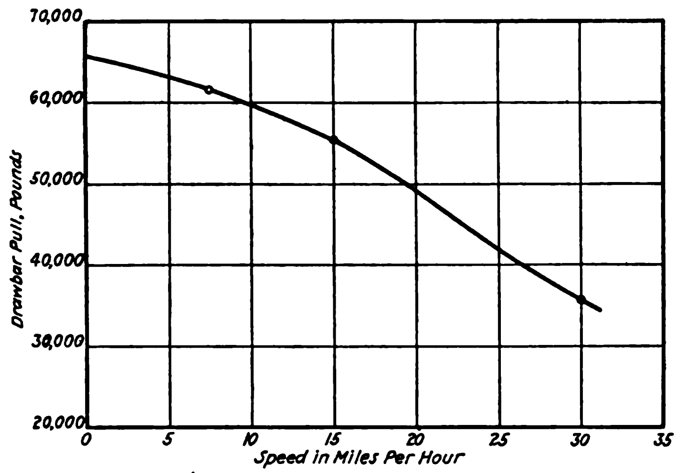


Fig. 9—Drawbar pull at various speeds

a test at 160 r.p.m., 50 per cent cut-off and full throttle showed the limit of the boiler to have been reached at an evaporation of 46,440 lb. per hour. The pressures at the top rim of the stack were small and most of them negative, indicating a vacuum of 4 in. to 7 in. of water, which showed that the stack was not filled. The exhaust nozzle was then increased in diameter to 7 in., retaining the basket bridge, after which an evaporation of 55,000 lb. per hour was obtained.

Notwithstanding the improvements resulting from the changes just described, the firing on heavy load tests was still difficult and the locomotive did not steam freely.

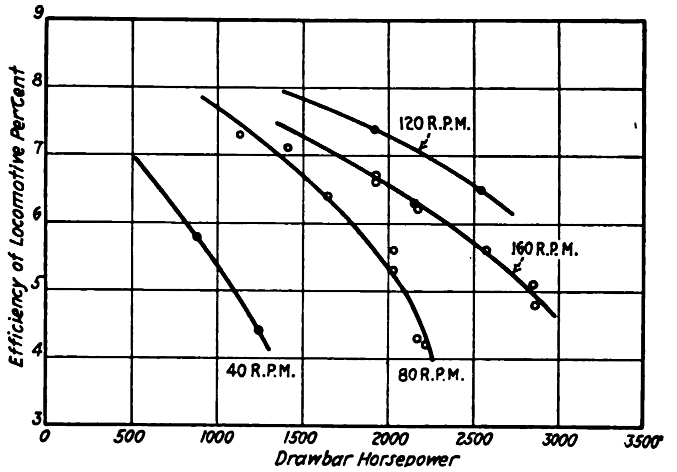


Fig. 10—Overall efficiency of the locomotive at various speeds and loads

Finally, the basket bridge was removed and Goodfellow projections were added to the 7-in. diameter nozzle, and this, with the Lls. stack, was found to make the steaming and draft conditions very satisfactory. It was now found possible to reach an evaporation of 59,900 lb. per hour and later, 61,680 lb. The latter figure corresponds to 12.6 lb. per square foot of heating surface per hour.

Results of tests

A total of 28 runs were made while the locomotive was on the test plant. The duration of the runs was from 15 minutes to two hours, the majority of them being one

Summary of tests on Missouri Pacific three-cylinder Mikado locomotive No. 1699

Test designation R.P.M. cut-off throttle	Coal as fired per hr., lb.	Dry coal fired per hr., lb.	Coal as fired per hr. per sq. ft. grate, lb.	Dry coal fired per hr. per sq. ft. grate, lb.	Water evaporated per hr., lb.	Equivalent water evaporated per hr., lb.	Water evaporated per lb. of coal as fired, lb.	Equivalent water evaporated per lb. of dry coal fired, lb.	Boiler pressure, lb. per sq. in.	Temperature of feed water, deg. F.	Temp. of steam at boiler pressure, deg. F.	Temperature of superheat, deg. F.	Temperature of superheated steam, deg. F.	Boiler efficiency, per cent
						Boiler Performances—Efficiency								
80-30-F	2,897	2,778	43.7	41.9	24,202	32,126	11.1	11.6	196	46	386.4	191.6	578	83
80-30-F	3,104	3,000	46.8	45.2	23,567	31,104	10.0	10.4	194	54	385.6	189.4	575	74
80-30-F	3,000	2,852	45.2	43.0	24,652	32,684	10.9	11.5	198	48	387.2	199.8	587	82
80-40-F	3,798	3,717	57.3	56.1	28,445	38,332	10.1	10.3	197	41	386.8	221.2	608	74
						Boiler Performances—Capacity								
160-50-F	8,821	8,636	133.0	130.3	48,925	67,349	7.6	7.8	198	44	387.2	279.8	667	55
160-60-F	10,429	10,173	157.3	153.4	59,920	82,877	7.9	8.1	199	41	387.6	281.4	669	58
120-60-F	7,285	7,056	109.9	106.4	51,974	71,845	9.9	10.2	198	42	387.2	285.8	673	70
160-60-F	11,340	10,626	171.0	160.3	59,867	83,453	7.4	7.9	198	41	387.2	304.8	692	54
40-90-F	5,275	5,005	79.6	75.5	34,504	46,890	8.9	9.4	198	44	387.2	248.8	636	65
160-60-F	12,589	11,948	189.9	180.2	61,680	84,705	6.7	7.1	197	44	386.8	271.2	658	49

Test designation R. P. M., cut-off, throttle	Total indicated horsepower	Coal as fired per i. hp. per hr., lb.	Dry coal fired per i. hp. per hour, lbs.	Steam per i. hp. per hr., lb.	Tractive force based on M.E.F., lb.	Drawbar pull average lb.	Machine efficiency of loco., per cent	Overal efficiency of loco., per cent
			Engine Performances—Efficiency					
80-30-F	1,294	2.2	2.1	18.7	32,291	26,693	83	7.2
80-30-F	1,268	2.4	2.3	18.4	31,642	26,571	84	6.7
80-30-F	1,339	2.1	2.0	17.3	33,414	28,256	85	7.3
80-40-F	1,605	2.3	2.3	17.7	40,052	35,110	88	7.1
			Engine Performances—Capacity					
160-50-F	2,868	3.0	3.0	16.8	35,785	32,112	90	5.6
160-60-F	3,141	3.3	3.2	19.0	39,191	35,488	91	5.1
120-60-F	2,752	2.6	2.5	18.7	45,783	42,330	92	6.5
160-60-F	3,176	3.5	3.3	18.7	39,628	35,718	90	4.8
40-90-F	1,364	3.8	3.6	24.7	68,076	61,847	91	4.4
160-60-F	3,117	4.0	3.8	19.6	38,892	35,375	91	4.3

hour long. In all but one short run the locomotive was stoker fired. A full throttle was used in all tests. Speeds were 40, 80, 120 and 160 r.p.m., or approximately 7½, 15, 22½ and 30.1 m.p.r. The first six runs were made with the smokebox arrangement as received and with a 6¼-in. exhaust nozzle tip. Changes were then made in smokestack and exhaust nozzles, after which 11 runs were made with the smokestack similar to the Pennsylvania L1s. or 2-8-2 type locomotive and a 7-in. exhaust nozzle with Goodfellow projections. A general summary of the boiler and engine performances as ascertained by typical tests is shown in the accompanying tabulation. In the tables the first group or efficiency tests were with the original smokebox arrangement and the second group or capacity tests were made with the modified smokebox arrangement.

The boiler performance was excellent as its evaporation ranges from 6.7 lb. to 11.1 lb. of water per pound of coal as fired, according to the speed and the amount of coal burned per square foot of great area per hour which ranges from 43.7 lb. to 189.9 lb. The boiler pressure was maintained near its intended pressure of 200 lb. per sq. in. The boiler efficiency at 11.1 lb. of water evaporation per pound of coal was 83 per cent—very good even in stationary service—and was 49 per cent at the time when the boiler was forced to its limit at high speed and at its maximum evaporation of 61,680 lb. or an equivalent evaporation of 84,705 lb. per hour. The superheat in the steam was always near 250 to 280 deg. F, making the total temperature of steam approximately 675 deg. F.—a desirable condition of superheat. All results show the boiler to be well proportioned in firebox, grate area, heating surface and steam space and also in superheating surface.

The engine performance was equally as good. The calculated nominal tractive force is 65,700 lb. and the locomotive developed a drawbar pull of 61,847 lb. at a speed of 7½ miles per hour and 90 per cent cut-off. The maximum power developed was 3,176 hp. which was reached at a speed of 30 miles per hour and 60 per cent cut-off, with an engine efficiency of 90 per cent. The maximum engine efficiency of 94 per cent was reached at a speed of 15 miles per hour and 80 per cent and 90 per cent cut-off, which shows an excellent performance for the locomotive.

Additional information relative to the performance of the boiler and the engine of this three-cylinder locomotive will be obtained by an examination of the accompanying diagrams and typical indicator cards.

In previous tests of two-cylinder locomotives on the testing plant it was found that the fore and aft motion or vibration due to the unbalanced reciprocating parts became so severe at a speed below 200 r.p.m. that additional balance weights were needed in the wheels for test plant operation and it has been customary to add sufficient weights to balance completely all the reciprocating weights. With this three-cylinder locomotive no additional balance weights were applied and a speed of 235

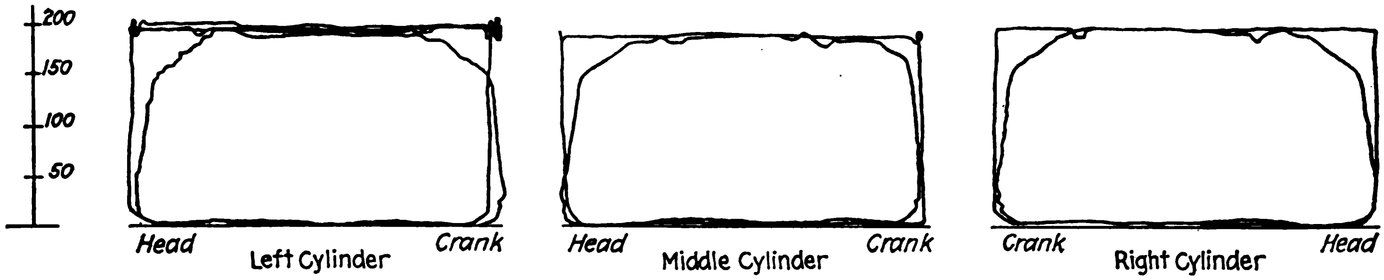


Fig. 11—Typical indicator cards at 7.5 m. p. hr., 90 per cent cut-off and 1,364 indicated horsepower

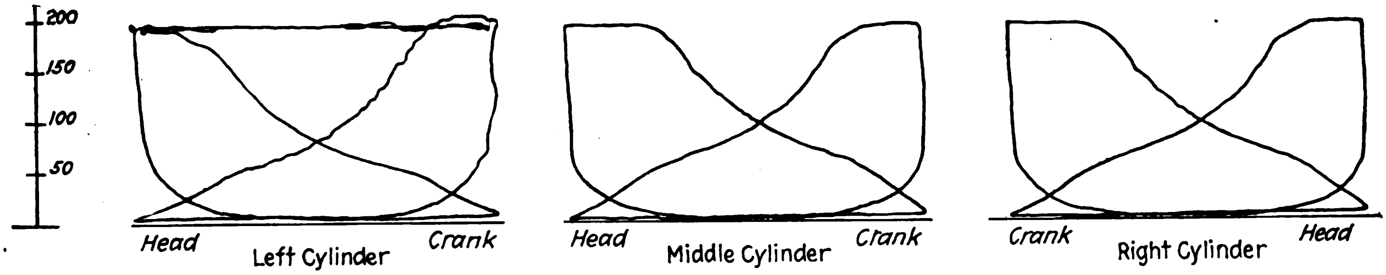


Fig. 12—Typical indicator cards at 15 m. p. hr., 30 per cent cut-off and 1,339 indicated horsepower

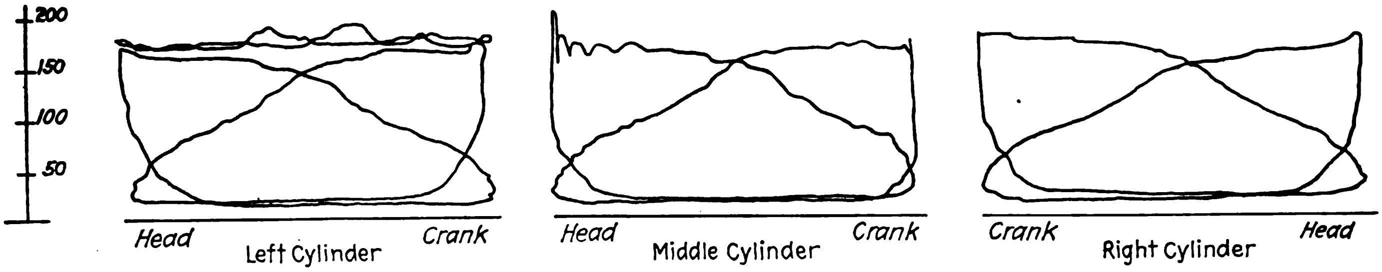


Fig. 13—Typical indicator cards at 30.1 m. p. hr., 60 per cent cut-off and 3,176 indicated horsepower

r.p.m. was reached before the fore and aft vibration became violent enough to endanger the mechanism of the dynamometer. It was the conclusion that without special counterbalancing a two-cylinder locomotive could be operated safely at a speed of 180 r.p.m. and a three-cylinder locomotive at a speed of 240 r.p.m., or at approximately one-third greater speed. At all speeds the drawbar pull lines were more even than those obtained from two-cylinder locomotives.

No measurements were taken of the turning moment or torque for comparison with the usual two-cylinder arrangement.

In conclusion it may be said that with the exception of the front end arrangement the efficiencies of both boiler and engine and the boiler capacity were excellent. This will be evident from a comparison of the results of the tests of this locomotive with those of two cylinder locomotives of comparable dimensions.

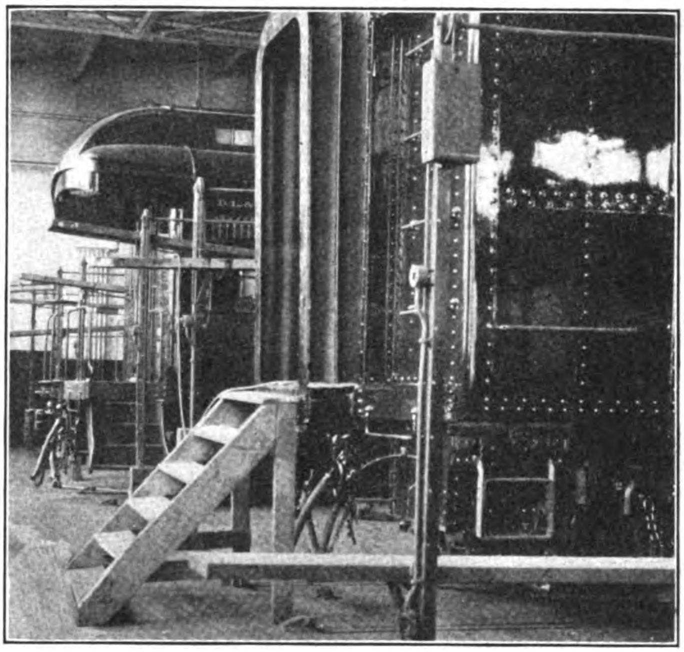
Table of dimensions, weights and proportions

Railroad	Missouri Pacific
Type of locomotive	2-8-2, 3-cylinder.
Service	Freight.
Cylinders, diameter and stroke, outside	23 in. by 32 in.
Cylinders, diameter and stroke, inside	23 in. by 28 in.
Valve gear, type	Baker.
Valves, piston type	——
Maximum travel	6½ in.
Outside lap	1⅛ in.
Exhaust clearance	0
Weights in working order:	
On drivers	244,500 lb.
On front truck	34,500 lb.
On trailing truck	61,000 lb.
Total engine	340,000 lb.
Tender	190,100 lb.
Wheel bases.	
Driving	17 ft. 10 in.
Total engine	37 ft. 5 in.
Total engine and tender	72 ft. 3½ in.
Wheels, diameter outside tires:	
Driving	63 in.
Front truck	33 in.
Trailing truck	43 in.
Boiler:	
Type	Straight top.
Steam pressure	200 lb.
Fuel, kind and B. t. u.	Bitum.—13,300.
Diameter, first ring, inside	88 in.
Firebox, length and width	114⅛ in. by 84¼ in.
Height mud ring to crown sheet, back	68⅝ in.
Height mud ring to crown sheet, front	90½ in.
Arch tubes, number and diameter	2, 3 in.
Thermic syphons	2
Tubes, number and diameter	199, 2¼ in.
Flues, number and diameter	45, 5½ in.
Thickness tubes and flues	.120 in.—.148 in.
Length over tube sheets	19 ft.
Net gas area through tubes and flues	8.5 sq. ft.
Air inlet through grates	26.9 sq. ft.
Air inlet above fire bed	1.1 sq. ft.
Air inlet to ash pan	14.5 sq. ft.
Grate type	Table.
Grate area	66.3 sq. ft.
Heating surfaces:	
Firebox and syphon	335 sq. ft.
Arch tubes	14 sq. ft.
Tubes	2,214 sq. ft.
Flues	1,223 sq. ft.
Total evaporative	3,786 sq. ft.
Superheating	1,051 sq. ft.
Comb. evaporative and superheating	4,837 sq. ft.
Special equipment:	
Brick arch	Yes
Superheater	Type A
Feedwater heater	No
Stoker	Elvin
Tender:	
Water capacity	10,000 gal.
Fuel capacity	16 tons
General data estimated:	
Rated tractive force, 85 per cent	65,700 lb.
Cylinder horsepower (Cole)	2,737
Speed at 1,000 ft. piston speed	35.2 m.p.h.
Steam required per hour	51,900 lb.
Coal required per hour, total	8,800 lb.
Coal rate per sq. ft. grate per hour	134 lb.
Weight proportions, estimated:	
Weight on drivers ÷ total weight engine, per cent	71.9
Weight on drivers ÷ tractive force	3.72
Total weight engine ÷ cylinder hp	124.2 lb.
Total weight engine ÷ comb. heat. surface	70.3 lb.
Boiler proportions, estimated:	
Comb. heat. surface ÷ cylinder hp	1.76
Tractive force ÷ comb. heat. surface	13.58
Tractive force × dia. drivers ÷ comb. heat. surface	856
Cylinder hp. ÷ grate area	41.3
Firebox heat. surface ÷ grate area	5.26
Cylinder hp. ÷ gas area (tubes and flues)	322
Grate air inlet ÷ grate area, per cent	40.5
Ash pan air inlet ÷ grate area, per cent	21.8
Firebox heat. surface, per cent of evap. heat. surface	9.2
Superheat. surface, per cent of evap. heat. surface	27.8
Tube length ÷ inside diameter	113

Convenient steps for use in coach repair shops

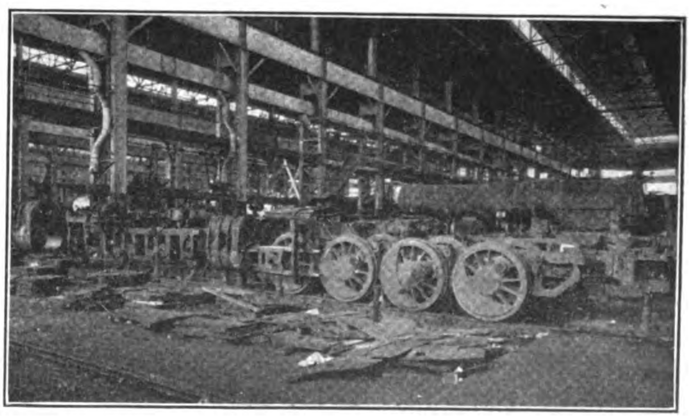
It is often the case that the most simple arrangement used in a repair shop proves to be a time-saving device of some moment. Such is the case with the flight of wooden steps shown in the illustration which is used in the Kingsland shops of the Delaware, Lackawanna & Western.

It was observed from past experience that it was not



Steps placed for easy entrance into a dining car

unusual to have, in the coach shops, several cars with all the steps removed, or dining cars which have no steps for easy entrance. This condition naturally made it difficult for the workmen to get in and out of these cars and especially difficult to carry in material. As a result, several flights of wooden steps were built just high enough to be level with the vestibule platform of the cars. These steps are placed at the rear of the platform which afford the workmen easy access to the cars. Furthermore, bulky or lengthy materials may be carried into the car without having to make a sharp turn as is the case when using a side entrance.

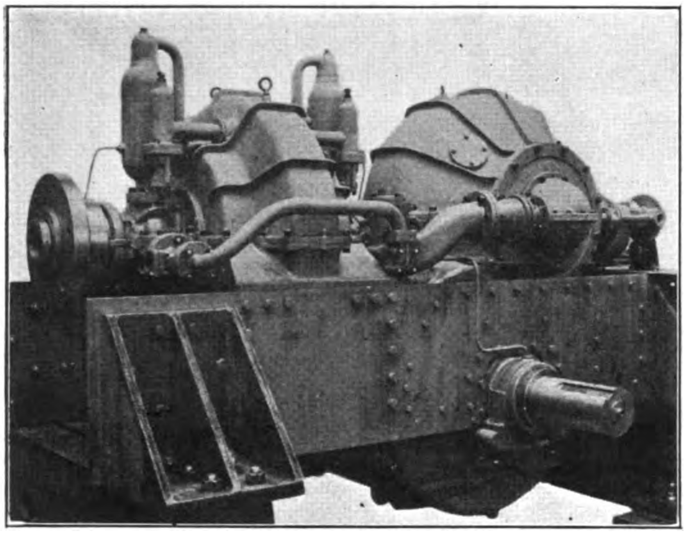


Interior view of the erecting shop at the Eddystone Plant of the Baldwin Locomotive Works, Philadelphia, Pa.

Schneider hydraulic transmission for Diesel locomotives

Combination of mechanical and hydraulic coupling employed—Tests show high efficiency

ALL hydraulic transmissions which up to this time have been developed to the point of application on locomotives or motor cars have operated on what might be termed a full hydraulic coupling principle, the power being transmitted hydraulically and speed regulation obtained by driving and driven pumps in the primary and secondary elements. The applied power is absorbed by the primary element, converted into hydraulic pressure and velocity and then reconverted into mechanical energy in the secondary pump, which acts as a motor, thus transmitting the power to the driven shaft, the speed of which is regulated by varying the delivery volume and pressure of the oil.



Schneider hydraulic transmission completely assembled—This is a 500-hp. equipment

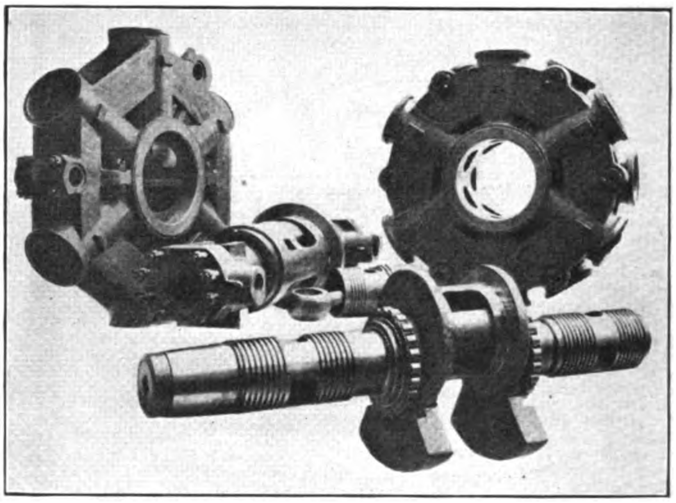
The Swiss Locomotive & Machine Works, Winterthur, Switzerland, is manufacturing a hydraulic transmission which differs materially in principle and construction from the usual type. The patent rights on this development are controlled by Heinrich Schneider, Winterthur, Switzerland, and G. A. Schneider, Montreal, Quebec.

The primary and secondary elements of the Schneider gear, in addition to being hydraulically coupled, are both coupled mechanically to the jack shaft from which the power is transmitted to the driving wheels. With this arrangement a varying portion of the power is transmitted directly to the jack shaft, the rest being hydraulically transmitted through the driving and driven pumps. That portion of the power which is transmitted hydraulically can be regulated from zero to maximum, according to the ratio of transmission, so that at one predetermined speed, hydraulic conversion is entirely eliminated, together with any consequent hydraulic efficiency losses.

Description of the gear

The first gear of this type was produced for use in a 500-hp. Diesel locomotive. The gear, as a whole, is made up of a primary and secondary element, both of which are mechanically coupled through gearing to a jack shaft which drives, through cranks and connecting rods, the driving wheels of the locomotive.

The primary element consists essentially of a hollow crank shaft directly coupled to the Diesel engine crank shaft, a rotor mounted on the shaft and a stationary housing which is attached to the locomotive frames. The crank shaft is a hollow heat-treated steel casting. The offset of the eccentric portion is 2⅜ in. The shaft is designed with a diagonal bridge wall which separates the intake oil end from the discharge end, providing a passage into one end of the hollow shaft, thence through ports on one side of the eccentric portion of the shaft into the rotor cylinders and, on the other side through an opposite set of ports, from the cylinders into the other end of the shaft. The ends of the shaft revolve in labyrinth packings mounted in the gear casing. Above the labyrinth stuffing boxes air domes and relief valves are provided in order to take up shocks and to allow the oil to escape



From left to right—the primary cylinder block, the secondary axle, one of the pistons, the primary shaft and the secondary cylinder block

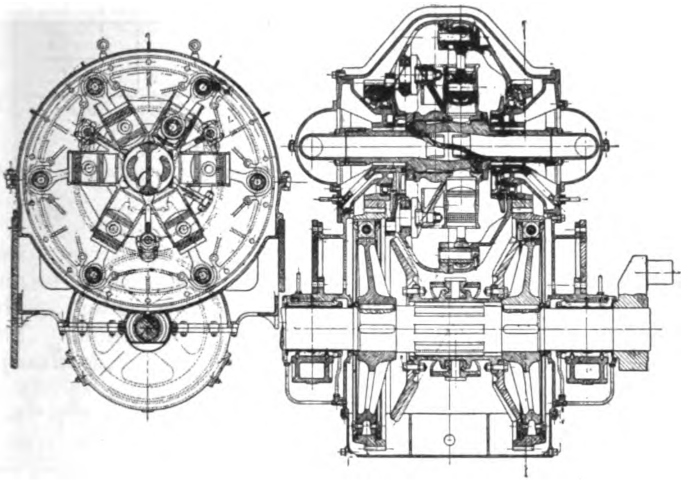
to the outer casing should the pressure exceed a predetermined limit.

The rotor is made up of three elements: the casing, a cylinder block and the pistons which operate in the cylinders. The rotor casing revolves on roller bearings about the axis of the shaft and is also mounted in roller bearings carried in the main casing of the primary element. Mounted on the outside of the rotor casing at each end is a spiral gear ring. These mesh with two corresponding spiral gears keyed to an intermediate shaft, upon which is carried a spiral bevel gear that drives on the jack shaft. Inside of the rotor casing is a cylinder block mounted on the eccentric portion of the primary crank shaft which revolves in the cylinder block on soft metal liquid-tight bearings. The cylinder block contains six cylinders and

is cast in two halves with the cylinders arranged radially in one plane. These cylinders are open at their outer ends to receive the pistons which are secured to the rotor casing by means of connecting rods. The cylinder block in operation moves about within the rotor casing in a circular orbit, the radius of which is equal to the throw of the eccentric portion of the primary crank shaft. To prevent the cylinder block from changing its angular position with respect to the rotor casing, it is secured to the casing by three links which are free to revolve about their bearings in the casing. The length of these links is equal to the throw of the primary crank shaft.

The primary element transmits the mechanical portion of the power input to the jack shaft by means of the bevel gears. Two driven bevel gears are placed on opposite sides of the driving gear. They are mounted on a spline tube which may be moved laterally on the jack shaft in order to throw either one or the other into mesh with the driving gear, thus producing the forward or reverse motion of the jack shaft.

The secondary element is composed essentially of three parts: the shaft, the rotor and the stationary outer casing. The shaft of the secondary element is not a shaft in the true sense of the word, but is, in effect, a stationary hollow axle about which the rotor revolves. Provision is made for its horizontal displacement from the center about which the rotor revolves, on guides attached to the outer stationary casing. This imparts an eccentric motion of variable throw to the cylinder block. To either end of this axle is attached an elbow which is mounted within a telescoping stuffing box. To these boxes the oil pipes are connected. In a similar manner to that of the primary crank shaft, a diagonal bridge wall divides the two ends of this axle into two separate chambers which open through ports at the center to the cylinders of the rotor element. The rotor of the secondary element consists of

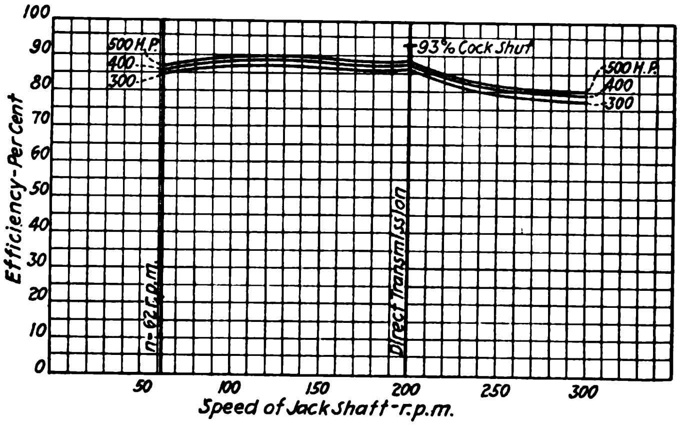


Sections through the primary (left) and secondary (right) elements taken parallel to the axis of the jack shaft

the same essential parts as that of the primary element. At either end of the rotor casing are mounted spiral gear rings which mesh with spiral gears keyed to the jack shaft. The cylinder block contains 12 cylinders arranged in two rows of six cylinders each in parallel planes. The outer ends of these cylinders are open to receive the pistons which are connected to the rotor casing by means of connecting rods. The link connections between the cylinder block and rotary casing of the primary element are replaced in the secondary element by six pin connections on the cylinder block, each of which rotates in a revolving block mounted in the motor casing. The pin bears in a slot extending across the diameter of the revolving block in which it is free to adjust its throw in conformity with the eccentricity of the axle with respect to the center of rotation of the rotor casing.

Method of operation

When the locomotive is at rest, the rotor of the primary element is held stationary by the gearing through which it is mechanically coupled to the jack shaft. The primary crank shaft, however, revolves with the Diesel engine crank shaft to which it is coupled. When the primary crank shaft rotates, it carries the cylinder block with it around its orbit within the rotor casing and the resultant movement of the cylinders over the pistons produces a



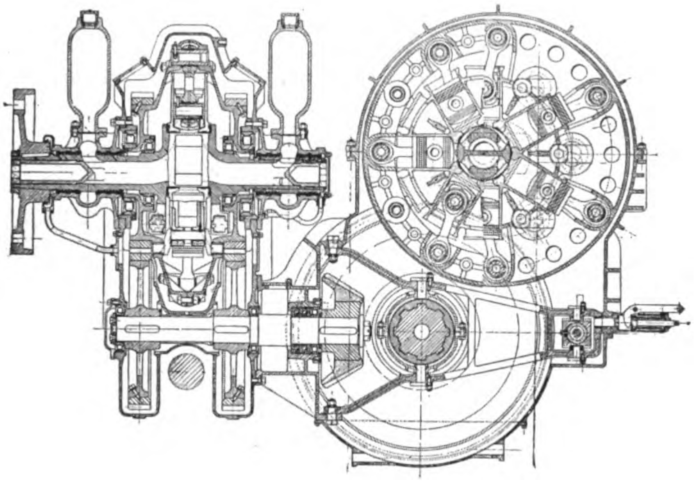
Curves showing the result of efficiency tests of the Schneider hydraulic transmission for constant engine power outputs

suction in three adjacent cylinders and pressure in the opposite three cylinders, thus causing circulation of the oil. The ports in the crank automatically control the admission and discharge of the oil to and from the cylinders.

Control valves are located in the piping connecting the primary and secondary elements and in a primary by-pass connection. In starting the Diesel engine without load and when the locomotive is standing with the prime mover in motion, the by-pass connection is open so that the oil freely circulates from the delivery side directly to the intake side of the primary element and no power is absorbed by the gear. To start the locomotive, hydraulic communication is established between the primary and secondary elements of the gear and the by-pass valve gradually closed, thus effecting a gradual loading of the engine and pick-up in the speed of the locomotive itself.

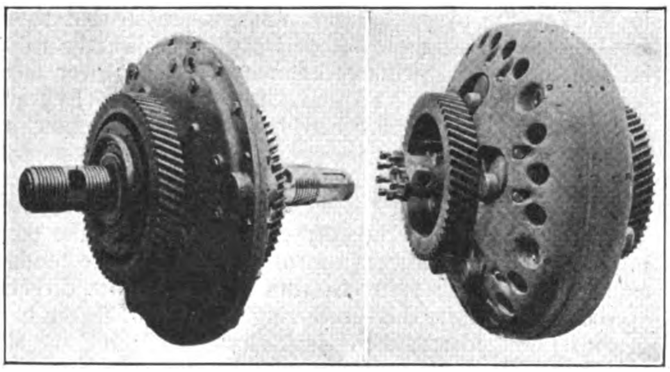
As the by-pass is gradually closed and hydraulic transmission built up, the reaction of the oil pressure tends to cause the primary rotor to rotate in the same direction as the crank shaft, this producing a reaction through the gears tending to rotate the jack shaft. At the same time the hydraulic pressure through the secondary element tends to cause the rotor of this element to revolve and this, through the gear connection, also reacts on the jack shaft. As the jack shaft gradually increases in speed with the engine running at constant speed, the revolutions of the primary rotor also increase in the same direction that the crank shaft is revolving, thus reducing the effective number of revolutions per minute of the crank shaft with respect to the rotor and correspondingly reducing the displacement of oil until a balance is reached when the volume of oil displaced by the primary element is equal to that displaced by the secondary element, the by-pass valve then being completely closed. This speed in the 500-hp. locomotive is 72.5 r.p.m. with the engine developing its full horsepower at 400 r.p.m. of the crank shaft.

To further increase the speed, the eccentricity of the secondary axle must be reduced, thus reducing the volume of oil displacement per revolution of the secondary rotor. Since the eccentricity of the primary crank shaft is fixed, a corresponding reduction in oil displacement is brought about through a further decrease in the relative speed of the crank shaft with respect to the primary rotor which results from an increase in the actual speed of the rotor and a corresponding increase in the speed of the locomo-



Section through the transmission taken at right angles to the jack shaft axis—The primary element is at the left and the secondary at the right

tive. The speed of the locomotive may be increased through this process until the eccentricity of the secondary shaft has been reduced to zero and the displacement of oil also reduced to a zero condition which requires that no further movement of the pistons in the primary element take place. The oil thus becomes, in effect, a solid body which locks the rotor of the primary element to the primary crank shaft, causing the former to revolve with the latter. Under this condition, the entire power of the



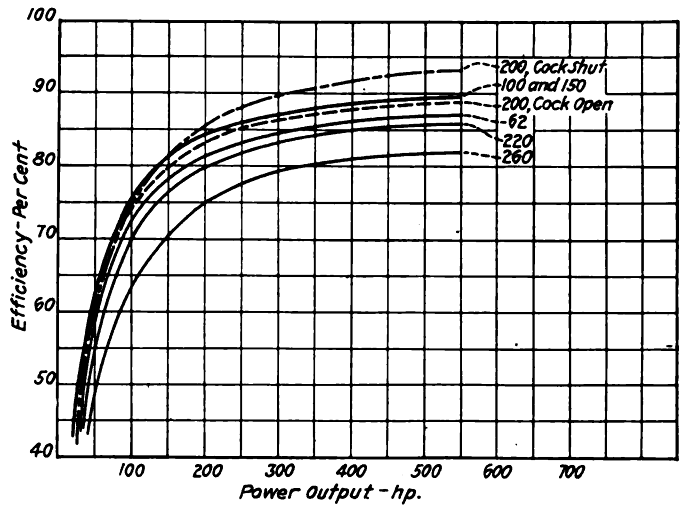
Primary (left) and secondary (right) elements of the Schneider hydraulic transmission

engine is transmitted mechanically from the primary element to the jack shaft, the secondary revolving idly. For the locomotive in question, this condition is reached at a speed of 230 r.p.m. of the crank shaft with full speed of the prime mover.

By referring to the diagram showing the efficiency characteristic of the transmission, it will be seen that for the 500-hp. locomotive the efficiency varies but slightly during the range of speed from starting up to the direct mechanical drive, and that it is slightly under 90 per cent. By closing the valve in the hydraulic connection from the primary to the secondary, thus relieving the secondary of pressure, the efficiency at this speed is increased to 93 per cent. The tests in which the efficiency of the transmission was measured were made with an electric motor driving the primary crank shaft at a maximum speed of 350 r.p.m., which accounts for the low-gear speed of the jack shaft of 62 r.p.m. and a direct drive speed of 200 r.p.m., instead of 72.5 r.p.m. and 230 r.p.m., respectively, for the full engine speed of 400 r.p.m.

By continuing the movement of the secondary axle beyond the neutral point to a negative eccentricity, further increase in speed of the locomotive may be effected. In this case the secondary element becomes the driving pump, taking the power from the jack shaft and transmitting it to the primary element which is caused to rotate in the same direction as its crank shaft, but at a greater speed than the crank shaft.

What takes place fundamentally through the range of operation of the transmission is evident from the torque characteristics of the two elements. The eccentricity of the primary crank shaft being fixed, the oil pressure in the hydraulic system remains constant under all operating conditions, except for sudden changes which may cause momentary increases, which are cushioned by means of



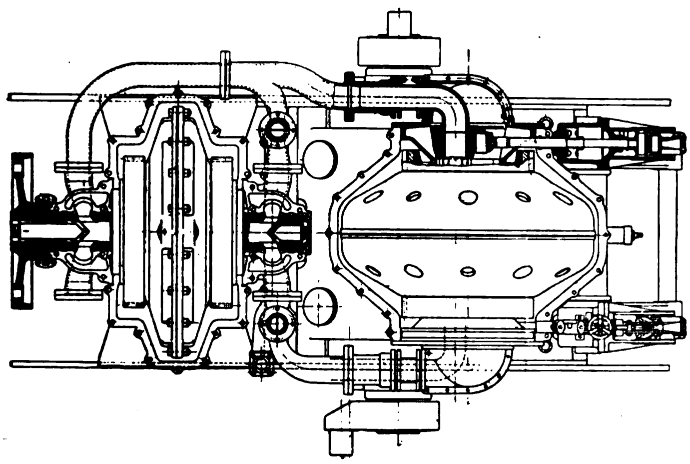
Efficiencies of the transmission for varying power outputs and jack shaft speeds

the air chambers. The constant oil pressure produces a constant torque in the primary rotor equal to the torque of the engine shaft. This torque is always acting on the jack shaft through the primary gear connections. The variation in the jack shaft torque required for the absorption of the full engine horsepower at varying speeds is effected by the secondary element, which delivers a positive torque varying from its maximum at the low speed, to zero at the direct drive and thence becomes negative in varying amount as the speed is increased above that of the direct drive.

The transmission may be reversed in two ways. If the eccentricity of the secondary axles is moved to its full amount on the negative side while the locomotive is standing, on beginning to close the by-pass valve the torque produced by the oil acting on the secondary pistons, is reversed, tending to revolve the jack shaft backwards. This movement, however, starts the primary rotor to revolve backwards on the primary crank shaft, thus increasing the speed of the rotor with respect to the crank shaft, increasing the rate of oil displacement and increasing the power output of the prime mover. This excess of power, of course, reappears at the secondary through the increased hydraulic performance and is in turn taken off the jack shaft through the forward reaction of the

primary gears working against the backward motion of the shaft. Under this condition the lowest speed at which a balance is reached (with the by-pass fully closed) is 195 r.p.m., a speed which reduces the tractive force to about one-third of the maximum at the forward motion low speed.

The other method of reversing the locomotive is to reverse the primary bevel gear drive as well as the eccentricity of the secondary axle. Under these conditions the operating characteristics are exactly the same as for forward motion.



Plan view of the 500-hp. transmission

The eccentricity of the secondary axle is controlled by means of two servo motors arranged in parallel, the operation of which is controlled by a single crank handle in the driver's cab. There are two hand wheels for effecting the hydraulic control. One operates the by-pass cock and another operates the valve by means of which the secondary gear is isolated and relieved of pressure in the case of direct mechanical transmission. The graduation of the stroke of the secondary pistons, the operation of the hydraulic cocks, the reversing of the primary gears and the control of the prime mover are all interlocked with each other so that no false maneuvering is possible.

Description of the Diesel locomotive

At this writing a four-cylinder, two-cycle, 500-b.hp. Diesel engine and the hydraulic gear described above, have been under test for some months at the plant of the Swiss Locomotive & Machine Works, Winterthur, Switzerland. The oil engine and gear have both been designed and tests conducted under the supervision of Heinrich Schneider, chief engineer of the company.

The oil engine employs a solid fuel injection system which does not involve the use of high pressure injection air. Both the oil engine and the gear are to be placed on a trial locomotive for the purpose of making experimental road tests. Some of the more prominent features of this two-cycle solid fuel injection engine consist of a special design of combustion chamber and of the arrangement of ports for the admission of scavenging air and allied control apparatus which allows the engine to be operated at high speed and at high efficiency. As previously described, the Diesel engine will be arranged lengthwise of the locomotive frames, the crank shaft of the engine being connected to the shaft of the primary element in the hydraulic gear by means of a flexible coupling on the engine flywheel. The mechanical transmission system from the engine to the gear is arranged in such a manner that the prime mover revolves in but one direction, all reversing being done within the hydraulic gear. The normal running speed of the engine is 400 r.p.m. and that of the floating shaft in the gear, 230 r.p.m. The estimated weight of the locomotive in working order is approximately 120,000 lb.

Designs have also been made for trial locomotives of 2,000 b.hp.

Report of air brake convention

Association is developing higher standards of maintenance and greater precision in testing

A BRIEF account of the early proceedings of the opening session of the thirty-second annual convention of the Air Brake Association, which was held at the Hotel Alexandria, Los Angeles, Cal., May 26-29, appeared on page 371 of the June issue. Later during the convention the following officers were elected for the year 1925-26: President, R. C. Burns, Pennsylvania; first vice-president, M. S. Belk, Southern; second vice-president, H. A. Clark, Soo Lines; third vice-president, H. L. Sandhas, C. R. R. of N. J.; treasurer, Otto Best, Nathan Manufacturing Company. F. M. Nellis was elected life secretary last year. The executive committee, including the new members, stands: W. W. White, M. C.; William Clegg, C. N.; R. M. Long, P. & L. E.; W. F. Peck, B. & O.; and C. H. Rawlings, D. & R. G. W.

The association voted to hold its 1926 convention at New Orleans, La.

In the following pages will be found abstracts or summaries of the papers, reports and discussions, most of which have an important bearing on the maintenance of air brake equipment.

Report on brake pipe leakage

The committee on brake pipe leakage submitted a progress report in which it summarized the purposes of the committee's investigations as follows: (1) To secure representative data on brake pipe leakage (as distinct from the brake system leakage) as it exists in current train service; (2) to secure data that will show the relation between air leakage from the brake pipe proper and the total leakage from the brake system; (3) to devise means for measuring and recording the total leakage of trains while being operated in regular service; (4) to secure data which will show the ratio of compressed air used for braking purposes and wasted in maintaining leaks; (5) to analyze the data with respect to the effect of leakage on brake operation; (6) to determine what degree of leakage in the brake system can be tolerated without serious interference in the brake action or operation; (7) to analyze the data with respect to cost of the compressed air wasted by leakage; (8) to analyze and compare current methods of inspecting and testing

for brake pipe leaks as well as for methods of repairs and maintenance.

The most important work undertaken by the committee was the development of a means for measuring continuously and recording automatically the total amount of air supplied while operating trains in regular service.

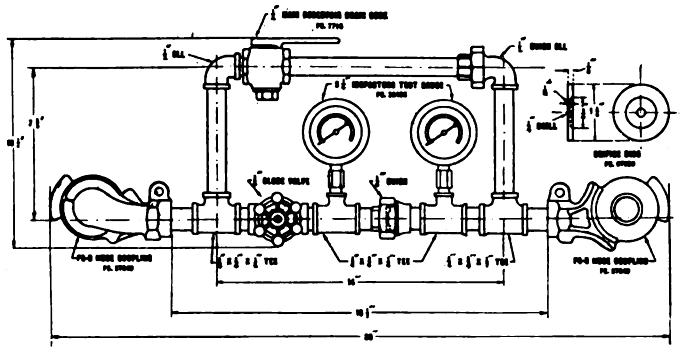
No. of Test	Brake Pipe Pressure Lbs. Front	Brake Pipe Pressure Lbs. Rear	No. of Cars	No. of 8" Equipments	No. of 10" Equipments	Pressure at Orifice Lbs. +	Pressure at Orifice Lbs. –	Average Cu. Ft. Free Air Supplied per minute	A.R.A. Leakage Test Lbs. per minute	Average Cu. Ft. Free Air Computed from A.R.A. Test	Average Cu. Ft. Free Air Supplied per minute per Car	Average Cu. ft. Free Air per Car Computed from A.R.A. Test	% Brake System to Brake Pipe Leakage
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	70	68	24		24	68	63	38.6	8	9.2	1.6	0.38	313
2	70	68	28		28	64	62	42.5	9	12.6	1.5	0.45	237
3	70	67	43		43	65	58	47.1	6	12.5	1.1	0.28	276
4	70	62	93	12	81	65	58	47.1	10	46.6	0.6	0.50	1.7
5	70	68	23	7	16	67	62	38.8	6	6.7	1.7	0.29	479
6	70	62	53	2	51	65	60	39.2	5	12.8	0.8	0.24	206
7	70	68	30	16	14	66	60	43.1	8	11.9	1.4	0.40	262
8	70	68	28		28	67	63	34.5	6	8.3	1.2	0.29	316
9	70	66	21	7	14	68	64	34.3	7	7.2	1.6	0.34	377
10	70	67	52	10	42	66	62	39.1	7	18.0	0.7	0.35	120
11	70	68	24	4	20	68	64	36.4	6	7.0	1.4	0.32	390
12	70	64	82	10	72	66	59	47.0	8	32.2	0.5	0.39	46
		Totals	501	68	433			485.7		185.0			

Average cubic feet of free air per car per minute (Brake system leakage) .97
Average cubic feet of free air per car per minute (Brake pipe leakage) .37
Percent increase of brake system over brake pipe leakage 162%

Data which determined the percentage of the brake system to the brake pipe leakage

The report showed in detail the apparatus used for this purpose as well as that employed while making a large number of tests under actual service conditions with train tonnages up to 4,475. The measuring and recording devices were installed in a test car which was piped so that it could be placed in the train directly behind the locomotive tender.

The total number of cars handled during these tests



Brake system leakage testing device

C. M. Kidd (Virginian) president

R. C. Burns (Penna.) first vice-president

M. S. Belk (Southern) second vice-president

H. A. Clark (Soo lines) third vice-president

were 2,768, of which 1,119 cars had 8-in. brake equipments and 1,649 cars had 10-in. equipments, the percentages being 40.5 per cent and 59.5 per cent, respectively. The total number of car-hours covered by these tests was 6,772.3 and 357,195 cu. ft. of free air was used to charge the test trains. Of this amount, 189,563 cu. ft. was consumed in brake pipe leakage. The percentage of brake system leakage in terms of brake pipe leakage was 88.5 per cent, or in other words, the leakage from the volume on the auxiliary reservoir side of the triple valve pistons was 88.5 per cent of the leakage from the brake pipe volume. Assuming that the legitimate use of the brake requires one full service application per car-hour of operation, only 3 per cent of the total amount of air is required to overcome leakage in the average brake system.

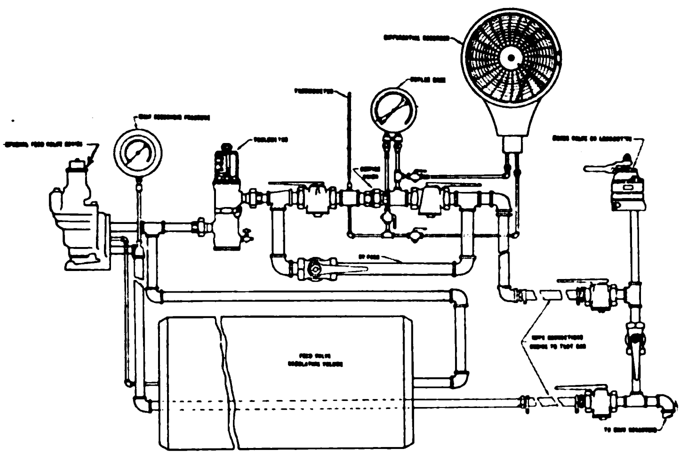
If the locomotive is equipped with the most modern type of air compressor, the amount of steam required to compress the air used per car-hour of operation would be 12.8 lb. For example, a 100-car train operating for 10 hr. would represent on the above basis, a total of 1,000 car-hours and the locomotive would be required to evaporate 12,800 lb. of water in order to supply the compressed air needed, making a total of 1,532 gal. of water. If it is assumed that the efficiency of the locomotive boiler will permit the evaporation of 7 lb. of water, to a pound of coal, 1,000 car-hours will require the burning of 1,830 lb. of coal on the locomotive in order to supply the necessary steam to the air compressor.

Figures compiled from the statistics of a railroad which owns between 900 and 1,000 locomotives show that the total operating freight car-hours during the year 1924 was 89,587,922 for a total of 10,930,392 cars handled. The cost of the compressed air used for the year on the basis of the average rate of air used found in these tests would be $409,864. Taking this on the basis that 97 per cent of the air supplied is wasted, the year's expense chargeable to brake system leakage would be $397,568.

The total number of leaks found on 2,424 cars tested was 10,634. These figures were the result of a questionnaire sent out to members of the association located in Canada and the United States. The total possible leaks on this number of cars that could be reported is 65,448, so that in these tests, leaks were found at 16.33 per cent of all the places tested, a ratio of one leak in every six possibilities. Of the 2,424 cars, 632 had 8-in. brake equipments and 1,792 cars had 10-in. brake equipments. The percentages being 26 per cent and 74 per cent, respectively. Of all the leaks found, 42.5 per cent were of such a nature as to be considered serious.

According to the committee, the most important fact brought out by the running tests was the exceedingly high

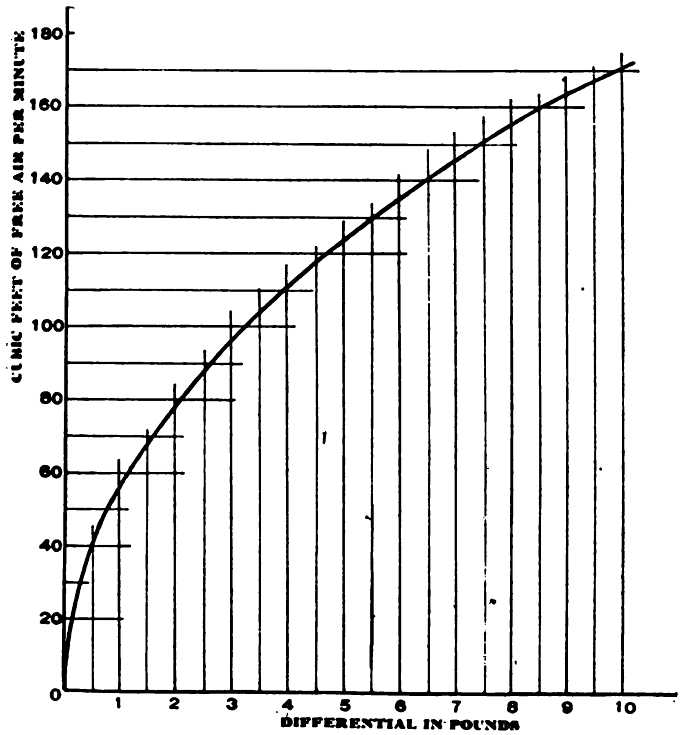
average rate of brake system leakage. The test showed that for the total of 6,772 car-hours of operation, the brake system leakage averaged about 53 cu. ft. per hour for each car or nearly 1 cu. ft. per minute per car. This leakage was made up of brake pipe leakage and auxiliary reservoir volume leakage, the latter being approximately 88 per cent of the brake pipe leakage. If it can be assumed that the running test data secured was representative, the amount of air actually required for brake operations was less than three per cent of the total amount which the compressor supplied to the train.



Measuring and recording apparatus used during running tests

The committee in closing its report, arrived at a number of conclusions, some of which are as follows:

That it is important that regular train inspection should include tests for brake system leakage as well as brake pipe leakage.



Running test—Curve showing relation between difference of pressures on two sides of 27/64 in. orifice and amount of free air used at 60 deg. F.

That a considerable portion of the brake system leaks can be found in the threaded joints of the pipe fittings and air brake equipment devices.

That the tests showed at least 97 per cent of all compressed air used in train operation is wasted by brake system leakage.

That the cost of air wasted and the reduced air brake efficiency due to brake leakage will amply justify a more extensive maintenance program.

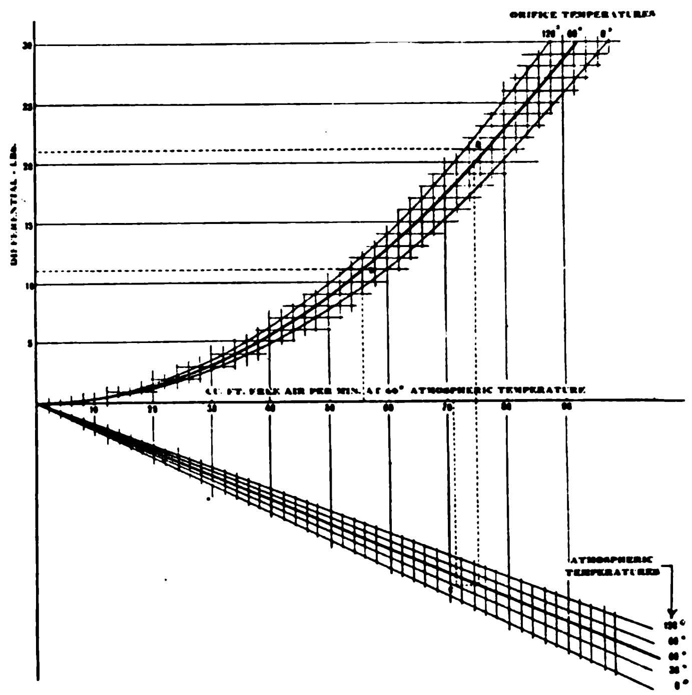
That poor brake equipment installation designs are frequently responsible for difficult brake equipment maintenance.

The committee also recommended that special attention be directed toward brake installation design of existing cars and new cars with a view to making improvements which will make leakage maintenance easier, such as better clamping, elimination of unnecessary pipe joints, reinforcement of pipe threads, etc.

The committee report was signed by C. H. Weaver (New York Central), C. B. Miles (C. C. C. & St. L.), W. W. White (Michigan Central), and R. E. Miller (Westinghouse Air Brake Company).

Discussion

The importance of differentiating between brake pipe and brake cylinder leakage was emphasized, and the necessity of eliminating as far as possible all leaks in the brake system, wherever found. Members of the association corroborated statements contained in the report regarding the wide prevalence of brake system leakage and the resultant heavy expense to the railroads in the way of increased fuel and compressor maintenance costs.



EXAMPLE (WITH TEMPERATURE CORRECTIONS)

Assume 21 lb. differential with orifice temperature 90 deg. F. and atmosphere temperature 30 deg. F.

Start at 21 lb. differential on the vertical scale and pass horizontally to intersect imaginary 90 deg. orifice line at "A." From "A" pass vertically downward to 60 deg. atmospheric line at "B." From "B" pass horizontally to 30 deg. atmospheric line at "C." From "C" pass vertically upward to answer on horizontal scale which is 71.0 cu. ft. of free air per minute.

EXAMPLE (WITHOUT TEMPERATURE CORRECTIONS)

Assume 11 lb. differential when orifice and atmospheric temperatures are 60 deg. F.

Start at 11 lb. differential on the vertical scale and pass horizontally to intersect 60 deg. orifice line at "X." From "X" pass vertically downward to answer on horizontal scale which is 55.5 cu. ft. free air per minute.

Calibration curves for brake system leakage testing device (¼-in. orifice, 70 lb. gage pressure on train side)

One member suggested that couplings be used when possible in place of unions to eliminate an extra joint and another called attention to the angle cock keys as a prolific source of leaks. He stated that many new cocks received from the manufacturers fail to pass the tests, although this is not always due to defective workmanship.

Of 200 such defective cocks, seven were caused by mishandling in shipment and the others passed the test successfully on being heated and the key turned a few times.

Mr. Miles stated in reply to a question, that the committee is not in a position at the present time to recommend definite leakage limits, but believes that the figure will be about 35 cu. ft. per minute.

The members were urgently requested to make the leakage testing device described in the report and after conducting tests on each road, submit as much information as possible on actual conditions. With this representative information at hand, the committee will be in a position to make definite recommendations in its report next year. The committee was continued.

More efficient air compressors

The possibilities of economy through better air compressor maintenance methods were pointed out in this report, which laid particular stress on the advantages of grinding as compared to boring both air and steam cylinders. The grinding of all cylinders at one setting without removing them from the center castings has been made possible by means of a machine now on the market, thereby obtaining the three advantages of smooth, accurate cylinders, reduced labor cost and accurate alinement of the cylinders, the latter a highly important factor in compressor efficiency and prevention of packing troubles. Comparative cost tables included in the report showed a cost of $374.50 for the boring operations on 100 9½-in. compressors as compared to $100 when the cylinders are ground.

The detailed costs of cylinder work on these 9½-in. compressors as well as on 100 11-in. compressors and 600 8½-in. cross compound compressors were as follows:

Cylinder work on 100 9½-in. compressors

Boring operation—			
2 cylinders removed	at	$.525	$52.50
2 cylinders replaced	at	.46	46.00
2 cylinders bored	at	.76	76.00
2 new gaskets at $.65	at	1.30	130.00
10 new cap screws at $.07	at	.70	70.00
		$3.745	$374.50
Grinding operation—			
2 cylinders ground	at	$1.00	$100.00
Saving			$274.50

Cylinder work on 100 11-in. compressors

Boring operation—			
2 cylinders removed	at	$1.34	$134.00
2 cylinders replaced	at	.73	73.00
2 cylinders bored	at	.96	96.00
2 new gaskets at $1.00	at	2.00	200.00
6 new bolts at $.11	at	.66	66.00
		$5.69	$569.00
Grinding operation—			
2 cylinders ground	at	$1.46	$146.00
Saving			$423.00

Cylinder work on 600 8½-in. c.c. compressors

Boring operation—			
2 pair cylinders removed	at	$.91	$546.00
2 pair cylinders replaced	at	.73	438.00
2 pair cylinders bored	at	2.00	1,200.00
2 new gaskets at $2.09	at	4.18	2,508.00
6 new bolts at $.07	at	.42	252.00
		$8.24	$4,944.00
Grinding operation—			
2 pair cylinders ground	at	$2.92	$1,752.00
Saving			$3,192.00

Saving in grinding over boring for one year

9½ in.	$274.50
11 in.	423.00
8½ in.	3,192.00
Total	$3,889.50

The total of this tabulation shows a saving effected for the year of $3,889.50, which represents six per cent interest on an investment of $64,825, or on the performance of the job alone, at the cost of $5,250 for the machine, the investment would be liquidated in 413 days.

Another source of loss of compressor efficiency mentioned in the report is radiation from the exposed top steam heads and backs of steam cylinders, which, on account of being hung low on the brackets, or perhaps located on the front end, present large radiating surfaces. It was recommended that compressor top heads and steam cylinders be jacketed all around.

Information of value regarding grinding wheels and their selection was also included in the report which was read by C. B. Miles, C. C. C. & St. L., representing the Pittsburgh Air Brake Club.

Condemning limits of A. R. A. standard triple valve parts

In accordance with the decision of the association at the Montreal convention, the committee on this subject submitted additional recommendations for consideration. Particular attention was called to the fact that shop facilities, gages, tools, etc., required at the time of repairs to triple valves have not kept pace with the improvements common in well-managed shops largely owing to the gradual though rapid increase in volume of this work. The report indicated that the time has now arrived when air brake shops should be provided with more modern appliances in order that repairs may be made to a uniformly high standard. A somewhat radical departure from previous reports was made through the recommendation of certain gages, tools,* etc., which the committee felt would result in economy when repairing triple valves and reduce the number of failures. Realizing the difficulties and expense involved if each railroad independently set about determining the amount of wear and limiting dimensions that should prevail for each of the component parts of triple valves, the committee went thoroughly into this question in conjunction with the triple valve experts of several railroads and with the manufacturers, and made definite recommendations as to the amount of wear allowable and the limiting dimensions. Tools, gages, appliances, etc., necessary or desirable in order to live up to the recommendations were illustrated in the report.

In order to make the report plain, it was divided into four parts, Division A being a key chart of all triple valve parts, Division B showing the limiting dimensions recommended, Division C explaining more in detail the necessity for following these limitations, and Division D showing drawings of tools and appliances mentioned in the report. This report forms an important addition to the literature on triple valve limits of wear and maintenance methods. The report was signed by R. M. Long, P. & L. E.; W. M. Cavin, A. C. L.; M. S. Belk, Southern, and J. R. McClintock, American Brake Company.

Discussion

There was considerable discussion of this report, which was referred to in highly complimentary terms by several members of the association. L. H. Albers, N. Y. C., called attention to the different problems in general confronting roads in the eastern and western sections of the country, these problems being stuck brakes in the former case and undesired quick action or dynamiting in the latter. He felt that the difficulties of the eastern men would be largely solved by improved standards of maintenance if the condemning limits recommended in the

*Drawings of these gages and tools will appear in subsequent issues of the *Railway Mechanical Engineer.*

report for triple valve parts were lived up to. Mr. Albers questioned the advisability of permitting triple valve bushings to be continued in service with wear up to .012 in. as allowed in the report. He recommended thorough service tests with triple valves worn to the maximum diameter in conjunction with the smallest pistons allowable to determine the rate of build up of brake pipe pressure in releasing, feeling that this is the real answer to the problem of stuck brakes.

The undesired quick action obtained on western roads was generally felt to be caused by extreme temperature variations between mountain and desert country expanding the pistons and rings, with the result that they stick in the bushings. This action is very uncertain and erratic, however, and the western representatives felt strongly that there is not sufficient spread between service and emergency applications and that the only remedy is in a heavier graduating spring. Tests are now being conducted under the auspices of the A.R.A. to determine if a heavier spring can be used to increase this spread without diminishing in any way the safety feature.

The members strongly recommended having triple valves repaired by air brake companies or else in a few centralized shops on each road where the high class work necessitated by the limits established in this report can be properly supervised. No work but cleaning and oiling should be permitted at small car repair points and rip tracks.

The report was accepted and the committee discharged with thanks.

Air brake and air signal piping

This report considered in some detail the relative merits of wrought iron and steel tubing for air brake and air signal pipes, the comparison being strongly in favor of the former. A brief explanation was also given of various methods of protecting the pipe, such as galvanizing, by immersion in a bath of molten zinc; sherardizing, by revolving the pipe in a drum containing a zinc powder resembling cement; electro-galvanizing, by the electroplating process; calorizing, by revolving in a drum containing aluminum powder; and leadizing in which the lead coating is obtained by precipitation from lead solution; electro-plating, hot dipping or a combination of the three. The following disadvantages of these processes were noted in the report:

1.—The coatings are thin and not continuous.

2.—Difficulty in some cases in obtaining any, or a good, coating on the inside of long pieces of small pipe.

3.—Precipitated or electro-deposited coatings are always porous.

4.—Lead, tin or copper are of such an electro-chemical character, with respect to iron or steel, that corrosion of any exposed pipe metal is aggravated, and pitting results. This is a serious matter with pipe threads, that are exposed, and the inevitable breaking of the coating due to the use of pipe wrenches.

5.—The most important disadvantage is the impossibility of bending any of these coated pipes without danger of breaking the coating and exposing portions of the pipe metal to corrosion.

The committee advised that the present recommended practice of the association as to piping be continued upon the following premises:

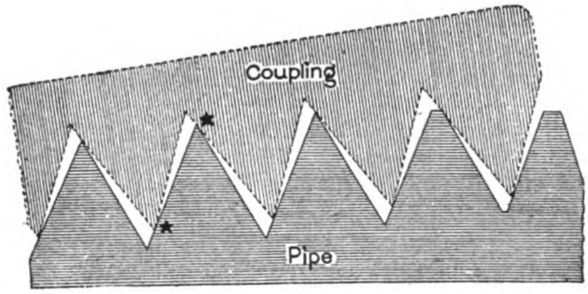
1.—Since the physical characteristics of wrought iron as compared with steel make it much more suitable for use under constant vibration with moisture-laden air, and it is now available in the open market, it should unquestionably be our standard.

2.—As no coating has been developed which will insure protection against corrosion, and at the same time permit of bending pipe, as is essential in air brake work, without danger of rupturing the coating and causing it to flake off and become troublesome in the system, we are opposed to the use of any of these coated pipes.

3.—As the production of wrought iron pipe is small as yet compared with that of steel pipe, the cost of the former must be somewhat greater than that of the latter, but in our judgment it is money well spent, and will be amply repaid in reduced maintenance and much longer life. Furthermore, we do not believe that the additional cost of coated pipes will be repaid in the service rendered by these coatings, while on the other hand, they will unquestionably increase the cost of maintenance.

A proposed change in the recommended practice was also advocated in order to protect against inferior grades of wrought iron. It was suggested that with good wrought iron pipe the standard weight would be sufficient instead of using the extra heavy pipe.

In closing the report the committee called attention to the frequent inconsistency between the threading of pipes and the tapping of sleeve couplings. The recommendation was made that action be taken by the association in order that all fittings for air brake use be tapped on the same tapper as that used for threading the pipes so that contact between the threads will be continuous. Such fittings were said to be available. The committee approved the new "Reinforced" pipe fittings now being introduced for use in railroad service by the air brake manufacturers.



Exaggerated view of fit obtained when a straight-tapped coupling is screwed on a taper-threaded pipe. Stars indicate the only two points of contact between the threads. Tightening the joint mashes the tips of the threads

This report was signed by J. W. Walker, Penna.; W. W. Shriver, B. & O., and F. H. Parke, Westinghouse Air Brake Company.

Discussion

The association was practically unanimous in favor of wrought iron pipe for air brake and air signal piping and voted to adopt as recommended practice the use of uncoated wrought iron pipe made according to A. R. A. or A. S. T. M. specifications for wrought iron. There was a difference of opinion regarding the necessity for using extra heavy pipe on all classes of cars, but most of the members favored its use in connection on locomotive air brake pipes.

A representative of the steel companies stated that all the wrought iron needed can now be obtained on 10 to 20 days delivery and that the reason it is somewhat higher in price than steel pipe results from the fact that it must be hand puddled.

Several members emphasized the necessity of greater care in bending and particularly threading pipe at locomotive and car repair points. Chasers must be kept sharp and compound used to assure smooth, accurately cut threads, the condition of which is an important factor in brake system leakage. The futility of expecting one set of chasers to cut several sizes of threads accurately was pointed out. The use of taper threads on pipe and both male and female pipe fittings was recommended by some of the members.

General News

William H. Johnson, president of the International Association of Machinists, has been re-elected to that office, as appears from the report of the election canvassed at the headquarters of the association in Washington, D. C., on June 1. E. C. Davidson was re-elected secretary-treasurer, and Fred Hewitt editor of the Machinists' Journal.

B. & O. co-operative plan to give shopmen an extra month's work in 1925

Shop employees of the Baltimore & Ohio have earned for themselves about a month's extra work in 1925, according to Vice-president Galloway, as reported in the Baltimore & Ohio Magazine. The plan of co-operation with employees in the shops stipulates that in return for additional endeavor by the employees, the management undertakes to see to it that they are adequately rewarded. This they are trying to do, in the first place, by providing more stable employment. In 1924 heavy improvement work on cars and locomotives, ordinarily not done in the company's own shops, was diverted to them for this purpose. The labor cost on this extra work totaled $347,303. This was not sufficient to provide a full year of 48-hour-week work, but it ameliorated conditions considerably and now, for 1925, the company is planning to do extra work with a labor cost of $2,772,316 in its own shops. This sum amounts to about the same as the average monthly labor expense on maintenance of equipment—hence the statement that the employees are to secure an extra month's work by way of recognition of the benefit to the company of their co-operative efforts.

Up to March 4 the company had received 9,277 suggestions for improvements from employees under the co-operative plan—77.8 per cent of which had been put into effect.

Pennsylvania railroad apprentice school

With the completion of new and enlarged facilities, the scope of the Pennsylvania's apprentice school at Altoona, Pa., has been materially increased, so that approximately 400 apprentices are receiving the benefit of its courses of instruction. The school, which was temporarily discontinued in 1921, was reopened in January of the present year, but was confined to apprentices from the Altoona machine shop only. More room has since been provided by an extension of the building, and in addition to the machine shop boys, the school is now open to regular apprentices from the Juniata shop, the Altoona car shop, the South Altoona foundry, and the Middle Division.

School sessions are held after working hours from 7:00 to 8:30, and 8:30 to 10:00 p. m. on Monday, Tuesday and Wednesday, and from 4:30 to 6:00, 7:00 to 8:30, and 8:30 to 10:00 p. m. on Thursday and Friday, the boys being arranged in sections so that each will be given three hours' school work each week during the period of his apprenticeship. The curriculum provides for mechanical drawing, mathematics and mechanics bearing on shop work, study of materials of construction which deal with the manufacture of iron and steel, and characteristics of different kinds of steel as used in the shop. The courses are adapted for the apprentices in the trades of the different crafts, such as machinists, boilermakers, pipe fitters, and electricians.

Harriman memorial medals to be awarded

The E. H. Harriman Memorial Medals for the best record in accident prevention among American railroads will be awarded this year for the first time since 1916, according to Arthur Williams, president of the American Museum of Safety, New York. In making this announcement Mr. Williams said that analysis of Interstate Commerce Commission statistics indicates that there were fewer casualties among passengers and employees in railroad accidents during 1924 than during any of the preceding nine years. "Mrs. E. H. Harriman has authorized the resumption of the E. H. Harriman Memorial Medals for the year ending December 31, 1924," Mr. Williams said.

The Harriman Gold Medal will be given to the railroad which has the best record for accident prevention and health promotion throughout the system as a whole; a replica in silver will be awarded to the division of the road which has the best individual safety record; and a replica in bronze will be presented to the

Passenger cars installed and retired

Quarter	No. installed during quarter	No. retired from service during quarter	No. owned or leased at end of quarter
Full year, 1923	2,719	2,713	......
1924			
Jan.-March	699	431	54,519
April-June	698	552	54,668
July-September	668	544	54,783
Oct.-December	759	849	54,787
Full year, 1924	2,824	2,376	......
1925			
Jan.-March	609	589	54,594

Figures in remaining columns from Car Service Division, A. R. A. quarterly report of passenger cars, Form C. S. 55 A. Figures cover only Class I roads reporting to Car Service Division.

Locomotives installed and retired

Month—1924	Installed during month	Aggregate tractive effort	Retired during month	Aggregate tractive effort	Owned at end of month	Aggregate tractive effort	Building in R. R. shops
January	271	15,228,895	178	4,447,721	64,989	2,552,694,953	14
February	214	11,296,088	175	4,906,435	65,029	2,559,519,253	10
March	176	10,457,064	181	6,033,173	64,911	2,560,076,766	7
April	97	4,167,388	112	2,881,385	64,896	2,561,362,769	11
May	153	6,949,353	107	2,600,445	64,942	2,565,706,413	10
June	160	7,687,383	178	4,575,358	64,924	2,569,121,875	72
July	197	10,590,558	113	3,354,456	65,008	2,576,433,377	63
August	229	12,513,395	166	5,346,176	65,062	2,583,372,980	50
September	160	7,061,560	151	4,351,378	65,071	2,586,083,994	37
October	113	5,743,775	220	5,712,633	64,964	2,586,106,026	76
November	181	8,460,795	263	7,749,794	64,882	2,586,826,278	70
December	295	12,311,451	304	9,724,426	64,871	2,589,358,971	64
Total for year 1924	2,246	....	2,148	....	.....	....	..
January, 1925	167	7,455,971	213	6,242,079	64,824	2,590,525,478	81
February	125	6,233,494	169	5,118,878	64,779	2,591,618,849	77
March	138	6,249,721	170	4,888,933	64,747	2,592,979,637	83
April	171	7,498,252	409	13,126,135	64,509	2,587,347,354	82
May	147	7,930,840	172	5,329,461	64,484	2,589,912,779	80

Figures as to installations and retirements prepared by Car Service Division, A. R. A., published in Form C. S. 56A-1. Figures cover only those roads reporting to the Car Service Division. Figures of installations and retirements alike include equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

employee who, in the judgment of the road, has been most conspicuous in furthering accident prevention. The awards will be made by the following committee:

R. H. Aishton, President, American Railway Association.
Samuel O. Dunn, Editor, Railway Age.
John Jacob Esch, Interstate Commerce Commissioner.
Julius H. Parmelee, Director, Bureau of Railway Economics.
Arthur Williams, Chairman.

The conditions under which the awards will be made, which were worked out under the direction of Julius Kruttschnitt, include a table of weights providing a penalty fifty times as great for fatal accidents as for non-fatal. Railroads are required to report accidents in and around shops, on boats or wharves, at stations, freight houses, engine houses, coaling stations, water stations, and accidents which occur in connection with construction, repair, painting, and maintenance of equipment, as well as train accidents and train service accidents.

Copies of the conditions of competition and of the forms on which the accident data are to be submitted have been sent to the president of every Class I steam railroad in the United States. The award will be based on the accident experience of railroads during the calendar year of 1924.

Meetings and Conventions

The International Railway Supply Men's Association, during the exhibition held in connection with the International Railway Fuel Association Convention at Hotel Sherman, Chicago, May 26 to 29, elected the following officers: president, Bard Brown, Superheater Company, New York; vice-president, F. S. Wilcoxen, Edna Brass Manufacturing Company, Chicago; treasurer, W. H. Harris of the W. H. Harris Coal Company, Chicago; secretary, F. P. Roesch, Standard Stoker Company, Chicago. Members elected to the executive committee were M. K. Tate, Lima Locomotive Works, Lima, Ohio, L. G. Plant, National Boiler Washing Company, Chicago, W. H. Heckman, Harry Vissering & Co., Chicago, and C. O. Jenista, Barco Manufacturing Company, Chicago.

Great Northern to hold stores convention

The Great Northern held a system convention of stores officers at Superior, Wis., on June 19 and 20. This was the second annual meeting of the system store organization, which was inaugurated last year. Sessions were held in the Hotel Amboy, under the direction of the president, Howard Hayes, general storekeeper, and a general committee. Reports of committees and papers were presented on the following subjects: Scrap handling and reclamation; handling of building and bridge work sheets; developments at the annual meeting of Division VI, A. R. A.; short cuts and methods in store department accounting; handling and storing lumber; fire protection; mechanical appliances; beautifying store grounds; controlling and distributing store stock and the inspection and testing of material.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting September, 1925.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention September 2-4, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division. A. F. Steubing, Bradford Corp., 25 West Forty-third Street, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention week of September 14, 1925, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 27 to 30, inclusive, Hotel Sherman, Chicago.

CANADIAN RAILWAY CLUB.—C. R Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth street, Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt Street, New York, N. Y. Regular meetings second Thursday each month, Hotel Statler, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Annual convention Hotel Sherman, Chicago, September 22-24.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month except July, August and September, at Hotel Cleveland, Public Square, Cleveland.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention, Hotel Winton, Cleveland, Ohio, August 18, 19 and 20.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 1809 Capitol Ave., Omaha, Neb.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Annual convention September 8-11, Hotel Sherman, Chicago.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday each month, except June, July and August at 29 West Thirty-ninth Street, New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in each month, except June, July and August.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth Street, Cleveland, Ohio. Annual meeting September 15-18, 1925, Chicago.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 189 West Madison Street, Chicago. Regular meetings third Monday in each month, except June, July and August.

Freight cars installed and retired

Month—1924	Installed during month	Aggregate capacity tons	Retired during month	Aggregate capacity tons	Owned at end of month	Aggregate capacity tons	Building in R. R. shops
January	15,589	707,367	12,329	516,695	2,310,032	100,644,107	2,417
February	11,386	554,481	10,466	411,228	2,310,570	100,767,731	2,715
March	9,962	446,094	8,726	352,481	2,311,405	101,165,332	2,697
April	8,718	369,978	8,026	306,288	2,312,074	101,223,891	2,739
May	9,199	439,516	9,059	360,212	2,312,237	101,303,200	2,467
June	10,909	538,118	8,347	321,094	2,314,798	101,569,593	2,269
July	16,583	1,151,302	8,413	316,927	2,322,968	102,388,652	4,602
August	15,452	785,288	8,834	333,173	2,329,582	102,845,000	3,618
September	15,455	779,078	9,337	370,607	2,336,147	103,270,000	3,045
October	16,598	834,762	10,504	*418,816	2,342,149	103,688,000	*3,574
November	11,705	579,234	10,678	463,970	2,342,479	103,767,000	5,159
December	6,763	311,254	11,918	488,035	2,337,229	103,585,000	6,478
January, 1925	11,768	551,263	7,867	326,812	2,341,109	103,812,974	5,285
February	15,024	721,867	9,453	365,111	2,346,687	104,169,525	4,878
March	16,607	753,947	12,067	474,644	2,350,697	104,454,128	5,572
April	13,749	652,462	10,497	423,322	2,353,956	104,683,798	8,072

*Corrected figure.

Figures as to installations and retirements prepared by Car Service Division A. R. A. Figures cover only those roads reporting to the Car Service Division. They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

Supply Trade Notes

The Forged Steel Wheel Company has moved its office from 170 Broadway to 120 Broadway, New York City.

A. J. Jones, secretary and general manager of the Acme Machine Tool Company, Cincinnati, Ohio, died on May 31.

The Griffin Wheel Company, Chicago, has prepared plans for the construction of an additional plant at Salt Lake City, Utah.

The Hannauer Car Retarder Company, Chicago, has been incorporated to manufacture and sell car retarders and other specialties.

J. M. Davis, president of Manning, Maxwell & Moore, New York, has resigned to become president of the Delaware, Lackawanna & Western.

The Morton Manufacturing Company has appointed the Peden Iron & Steel Company, Houston, Texas, and San Antonio, its southwestern representative.

The Engineering Products Company, Rialto building, San Francisco, Cal., has been appointed Pacific Coast representative of the Clark Car Company, Pittsburgh, Pa.

Emmet K. Conneely, vice-president and manager of sales of the New York Air Brake Company, at New York, has been elected also a member of the board of directors.

The Achuff Railway Supply Company has been incorporated in St. Louis, Mo., to manufacture railway supplies. The incorporators are J. B. Black and W. D. Achuff.

W. C. Miner, general sales manager of the Railway Service & Supply Corporation, has removed his headquarters to Indianapolis, Ind., and the Chicago office has been closed.

Marshall A. Carlton has been appointed Baltimore representative of the Verona Tool Works, Pittsburgh, Pa., with headquarters in the Munsey building, Baltimore, Md.

The Crane Company, Chicago, has acquired property on India street, San Diego, Cal., and contemplates the erection of a factory branch and distributing plant to cost about $80,000.

George T. Willard, representative of the Rail Joint Company, has resigned to become a sales representative of the Railroad Supply Company. His headquarters will be in Chicago.

John A. Zupez has been appointed mechanical engineer of the More-Jones Brass & Metal Company, St. Louis, Mo. Mr. Zupez was formerly in the general mechanical engineer's office of the Missouri Pacific.

E. M. McLean, sales division manager of the Four Wheel Drive Auto Company, Clintonville, Wis., has been promoted to general sales manager. S. H. Sanford, formerly sales division manager, is now assistant sales manager.

Thomas O'Leary, Jr., formerly with the New York Air Brake Company, is now a special representative of the general railroad department, Johns-Manville, Inc., with headquarters at 409 Dooly Block, Salt Lake City, Utah.

Francis W. Pratt, assistant to president of the Goodell-Pratt Company, Greenfield, Mass., has been appointed sales manager to succeed Oscar W. Bardwell, who has resigned as general sales manager but who still remains a director of the company.

Woodson H. Hudson, vice-president of the Georgia Car & Locomotive Company, Atlanta, Ga., died on May 27 in Atlanta at the age of 64. Mr. Hudson for a number of years was connected with the Southern Railway in the motive power department.

The complete line of Garvin tapping machines formerly built by the Garvin Machine Company, New York, has been purchased by the Western Machine Tool Works, Holland, Mich. The Western Machine Tool Works will build a complete line of taper roller bearing equipped tapping machines.

Gunner R. Lundane, formerly manager of the New York office of the Black & Decker Manufacturing Company, has resigned to join the United States Electrical Tool Company, Cincinnati, Ohio, as special eastern representative. He will have his headquarters at the company's office, 50 Church street, New York City.

The New York district sales office of the Consolidated Machine Tool Corporation of America has been removed to 150 Broadway. The Betts Works, Colburn Works and Newton Works of the company are now located at Rochester, N. Y.; the Hilles & Jones Works, at Wilmington, Del., and the Modern Works, at Erie, Pa.

The Locomotive Stoker Company has acquired from the Elvin Mechanical Stoker Company the exclusive patent rights covering the Elvin shovel type stokers heretofore sold by that company, and with their ample facilities for manufacturing stoker equipment for locomotives they are now in a position to supply either the duplex or the shovel type as may be preferred.

The Hammond Brass Works, Hammond, Ind., manufacturers of brass valves and specialties, has placed a contract with the Austin Company, Chicago, for the design and construction of a new foundry and machine shop on Summer street. The new building is to be a 90-ft. by 300-ft. one-story steel structure, containing approximately 30,000 sq. ft. of floor space.

G. H. Webb has been appointed Philadelphia sales manager of the Central Steel Company, Massillon, Ohio. He succeeds A. B. Cooper who died at his home in Philadelphia on May 3. Mr. Webb had been identified with the Central Steel Company for more than eleven years. A branch office of the Central Steel Company has been opened at Los Angeles, Cal.

The Impact Register Company, Inc., Champaign, Ill., of which W. S. Redhed is president and treasurer, H. B. Morrow, vice-president, and L. A. Busch, secretary, has acquired from the Savage Impact Register Company the exclusive rights to manufacture and sell the Savage impact register for the measurement of impact in cars and elsewhere, and Edwin W. Savage has retired from active connection with the sale of this device.

The Safety Car Heating & Lighting Company, New York, has entered into an agreement with the Silica Gel Corporation, Baltimore, Md., for the development under exclusive license, of apparatus for use by railroads and other transportation refrigeration generally. The Safety Car Heating & Lighting Company's engineers, after investigation have decided that the use of Silica Gel for refrigeration is sound and gives promise of extended use.

J. W. Hubbard, of Pittsburgh, Pa., has purchased the controlling interest in the Detroit Seamless Steel Tubes Company, Detroit, Mich., and has been elected chairman of the board of directors. A. A. Templeton, formerly president and general manager, having disposed of his interest in the company, has been succeeded by C. H. Hobbs, who has been vice-president since January, 1922. There will be no other changes in the officers of the company or in the general policies under which it operates.

The Cleveland Punch & Shear Works Company, Cleveland, Ohio, has completed a plant extension program, including the addition of considerable new equipment that will result in an increase of about 50 per cent in its capacity. Robert J. Pardee has been appointed vice-president and works manager, and Arthur Schloz, press engineer. Both were formerly connected with the Toledo Machine & Tool Company, Toledo, Ohio, for about 15 years, Mr. Pardee as assistant to the president and Mr. Schloz as head designer.

J. R. McGinley has been elected chairman of the board of directors of the Duff Manufacturing Company, Pittsburgh, Pa., and is succeeded as president by Thomas A. McGinley. C. N. Thulin has been appointed vice-president in charge of the western sales division, having jurisdiction over the company's main offices and representatives in the middle west, south west, mountain states and Pacific coast. His headquarters, as heretofore, will be in the Peoples Gas building, Chicago. P. G. O'Hara has been appointed vice-president in charge of the eastern sales division which comprises the eastern, central and southern district offices. Mr. O'Hara's headquarters will be at 250 Park avenue, New York City.

The Niles-Bement-Pond Company and the Pratt & Whitney Company, which hitherto maintained joint general sales and accounting departments at New York, have recently moved the sales and accounting departments to the plants. That of the

Niles-Bement-Pond Company is at Hamilton, Ohio, and the Pratt & Whitney Company, at Hartford, Conn. The general executive offices of the two companies remain as formerly at New York; E. L. Leeds, general sales manager, has been appointed vice-president in charge of sales of both companies, with headquarters at New York; Harold F. Welch, New York district sales manager, has been appointed general sales manager of the Niles-Bement-Pond Company, with headquarters at Hamilton; W. P. Kirk, assistant general sales manager of the two companies, has been made general sales manager of the Pratt & Whitney Company; C. K. Seymour, secretary of both companies, is also vice-president, succeeding C. L. Cornell, resigned; Arlo Wilson, special accountant, has been appointed also assistant treasurer to succeed Walter R. Boom, resigned; E. L. Morgan, chief accountant of the Pratt & Whitney Company at New York, has been transferred to the Hartford office; W. L. Burk, Jr., chief accountant of the Niles-Bement-Pond Company, has been transferred from the New York office to Hamilton, and George G. Greist, general manager of the Niles Tool Works, Hamilton, has been made general manager of the Niles-Bement-Pond Company, in charge of the Hamilton office.

Charles A. Starbuck, president of the New York Air Brake Company, died on May 29 at his home in Croton-on-Hudson, N. Y. Mr. Starbuck was born in Niagara County, N. Y., on September 17, 1852, and was educated in the public schools of his native county. He went to New York in 1870 and first worked in the office of a diamond merchant. He afterwards entered the brake business and became vice-president of the Eames Vacuum Brake Company. In 1890 he was elected secretary of the New York Air Brake Company, the successor of the Eames Vacuum Brake Company, the following year he became vice-president and in 1895 was elected president. Under his administration the business of the company expanded to its present large proportions in its field.

C. A. Starbuck

The board of directors of the Standard Tank Car Company has been reconstituted in accordance with a plan of readjustment adopted last February. The board as now constituted consists of: James Andrews, vice-president and general manager; Walter P. Chrysler, chairman of the board of the Maxwell Motor Corporation; William F. Cutler, president of the Southern Wheel Company; Duncan A. Holmes, vice-president of the Chase Securities Company; Stewart McDonald, president of the Moon Motor Car Company; Grayson M. P. Murphy, chairman of the board; J. B. Orr, president; Samuel F. Pryor, chairman of the executive committee, Remington Arms Company; and Ernest Stauffen, Jr., vice-president of the New York Trust Company.

The company's operating organization at Sharon, Pa., has been strengthened by the election of James Andrews as vice-president and general manager, and of Harry Graham as vice-president in charge of sales and operation. Mr. Graham was formerly vice-president in charge of sales of the Illinois Car & Manufacturing Company at Chicago. Substantial progress has been made by the company in the matter of new business and on June 1, the company opened an office at Tulsa, Okla., with F. S. Thompson in charge. In connection with the recent sale by the company of $4,250,000 of National Steel Car Line's equipment trust certificates, the Standard Transit Company was organized to take over the tank line business and the 2,757 tank cars formerly operated by the Tank Car Company, which are leased principally to the large oil companies. The directors of the Standard Tank Car Company will also serve as directors of the Standard Transit Company. The Standard Tank Car Company has an office at Sharon, Pa., and its plant is located at Masury, Ohio, 12 miles from Youngstown.

Trade Publications

Welding and cutting apparatus.—The Alexander Milburn Company, Baltimore, Md., has issued a 26-page brochure descriptive of the Milburn welding and cutting apparatus.

Gears.—Catalogue No. 46, embodying many recent additions to the list of standardized Boston gears, has been issued by the Boston Gear Works, Inc., Norfolk Downs (Quincy), Mass.

Threading machines.—"Thread with Landis" is the title of a 12-page illustrated booklet which has recently been issued by the Landis Machine Company, Waynesboro, Pa., descriptive of Land-Matic die heads.

Yoke riveters.—Bulletin R-205 descriptive of Hanna yoke riveters, which range in sizes from 4 in. to 21 ft. reach and in capacities from 6 tons to 150 tons, has been issued by the Hanna Engineering Works, Chicago.

Cranes.—Bulletin No. 36, illustrating and describing Type V cranes for mounting on motor truck chassis, road wheels, flexible crawling treads or rail wheels, has been issued by the Orton & Steinbrenner Company, Chicago.

Air-tight door.—The American air-tight door for ash pits, boiler settings and other locations where an air-tight door is needed, is described in a four-page folder issued by the Conveyors Corporation of America, Chicago.

Vises.—Catalogue No. 57-B listing discontinued Parker vises and illustrating their substitutes, has been issued by the Charles Parker Company, Meriden, Conn. Line drawings illustrate the various parts of Parker vises, and the names used to designate these parts are given.

Vertical surface grinder.—Complete description and specifications of the Blanchard high power vertical surface grinder are contained in catalogue No. 16, which has just been issued by the Blanchard Machine Company, Cambridge, Mass. The description is paralleled on the left-hand pages, with large illustrations and production data of a variety of work done on the machine.

Packings.—Catalogue A-1925 outlining the features of Garlock service and describing and illustrating its general line of packings—asbestos, rubber, metal and fibrous—gaskets, pump valves, valve discs, etc., has been issued by the Garlock Packing Company, Palmyra, N. Y. Colored illustrations are interspersed throughout the 176 pages of this catalogue, which is attractively bound in black leather.

Arc welding.—A resumé of the uses and value of automatic arc welding, together with a description of the welding apparatus and generating equipment used, is given in Bulletin No. 48937.1 entitled "Automatic Arc Welding," which has recently been issued by the General Electric Company, Schenectady, N. Y. This paper bound booklet contains 20 pages and is well illustrated by photographs of equipment and actual applications.

"Forty years of progress."—This is the title of a 64-page book issued by the Harnischfeger Corporation, Milwaukee, Wis., in which a concise history of its growth and development since its founding forty years ago, and photographs and descriptions of the entire plant and personnel as it is today are given. Each of the various products in the electric crane, hoist, machine tool and gasoline excavator lines, are also illustrated and described.

Brake beams and supports.—A loose-leaf catalogue containing 75, 6-in. by 9-in. pages of mechanical drawings of "Creco" equipment has been issued recently by the Chicago Railway Equipment Company, Chicago. The drawings presented have been selected to show the standards of the various types of brake beams, side bearings and "Creco" third and fourth point brake beam supports and safety devices manufactured by this company. The drawings and information contained in this catalogue are presented in an attractive form and logical sequence, the catalogue being intended as an aid in making satisfactory selections of equipment to meet all requirements and conditions of service. Brake beam repair parts can be ordered by numbers shown on spare part charts or by pattern numbers shown in the main body of the catalogue.

Personal Mention

General

A. O. Gertz has been appointed motive power inspector of the Eastern Pennsylvania division of the Pennsylvania.

D. L. B. Fringer has been appointed motive power inspector of the Central Pennsylvania division of the Pennsylvania.

Henry P. Hass, special assistant to the mechanical manager of the New York, New Haven & Hartford, has been appointed assistant to the mechanical manager. Mr. Hass is a graduate of Sheffield Scientific School, Yale University, of the class of 1907. He began railroad work on July 1, 1907, when he entered the service of the New York, New Haven & Hartford as a special apprentice. Two years later he was appointed material inspector and on December 1, 1911, he became chief material inspector. On February 1, 1916, he was appointed engineer of tests, which position he held until his appointment as office assistant to the mechanical manager on December 1, 1923.

Henry P. Hass

J. H. Reisse has been appointed mechanical inspector of the Chicago, Burlington & Quincy, with headquarters at Chicago.

T. B. Farrington has been transferred to Chicago as assistant general superintendent of motive power of the new Western region.

Frank E. Ballda, assistant to the mechanical manager of the New York, New Haven & Hartford, has been appointed mechanical superintendent, Lines East, with headquarters at Boston, Mass., succeeding B. A. Moriarty. Mr. Ballda began his railroad service as a machinist apprentice with the New York, West Shore & Buffalo (New York Central) in 1885. In November, 1889, he went to the Erie as a machinist and in January, 1890, to the New York, Chicago & St. Louis in the same capacity. Three months later he returned to the West Shore as a machinist and a year later was promoted to foreman. In May, 1896, he went to the Fitchburg as foreman. In 1897 he became a machinist for the New York, New Haven & Hartford, and the following year was promoted to roundhouse foreman. In March, 1904, he became assistant general foreman and in March, 1908, general foreman. In March, 1912, he was promoted to master mechanic and in May, 1915, to superintendent of shops at New Haven. In September, 1918, he became superintendent of shops at Readville, and in August, 1923, assistant to the general mechanical superintendent. In December, 1923, he was appointed assistant to the mechanical manager.

Frank E. Ballda

Frank H. Becherer has been appointed assistant to the mechanical superintendent of the Boston & Maine, with headquarters at Boston, Mass., succeeding Daniel A. Smith, who has been assigned to other duties.

A. C. Davis, formerly assistant chief of motive power—locomotive—has been transferred to Altoona, Pa., as assistant works manager, succeeding T. B. Farrington.

George A. Moriarty, mechanical superintendent of the New York, New Haven & Hartford, at Boston, Mass., has been appointed general mechanical superintendent, with headquarters at New Haven, Conn. Mr. Moriarty began his railroad career in 1887, when he started as a machinist apprentice on the Baltimore & Ohio. In March, 1891, he went to the Pittsburgh, Cincinnati, Chicago & St. Louis (Pennsylvania) as a machinist and served in this capacity subsequently with the Baltimore & Ohio, the Louisville & Nashville, the McNamar Machine Company, the Cincinnati, New Orleans & Texas Pacific, Jeffreys Machine Company, again with the Baltimore & Ohio, the Cleveland, Cincinnati, Chicago & St. Louis and the Columbus Machine Works. In September, 1895, he returned to the Baltimore & Ohio as machine shop foreman. In September, 1898, he again left that railroad, returning in July, 1899, as assistant roundhouse foreman. In February, 1901, he was promoted to roundhouse foreman and continued in that capacity until June, 1903, when he went to the Erie in a similar capacity. In 1904, he was promoted to general foreman and in October, 1906, to master mechanic. In 1907, he went to the New York, New Haven & Hartford as master mechanic, was promoted in January, 1917, to general master mechanic, Eastern grand division, and four months later to mechanical superintendent, Lines East.

G. A. Moriarty

William L. Bean, assistant mechanical manager of the New York, New Haven & Hartford, with headquarters at New Haven, Conn., has been promoted to mechanical manager with the same headquarters, succeeding L. M. Reed, resigned. Mr. Bean was born on January 3, 1878, and was graduated from the University of Minnesota in 1902, having completed a course in mechanical engineering. He immediately entered the service of the Northern Pacific as a special apprentice, and served in that capacity until late in 1904. On January 1, 1905, he became gang foreman of the Atchison, Topeka & Santa Fe. The following year he was promoted to inspector, and in 1908 to machine shop foreman. In 1909 he became division foreman, and a few months later, motive power assistant. In 1911, he was appointed bonus supervisor and held that position until early in 1912. He then entered the service of the Oxweld Railroad Service Company as chief engineer, remaining with that company until 1916. Mr. Bean went with the New Haven in July, 1916, and in September, 1917, was made assistant general mechanical superintendent, and on November 1, 1918, mechanical assistant to the president, acting in that capacity until December 1, 1923, at which time he was made assistant mechanical manager. His final work was that of assisting the president in his investigation of the property and in

W. L. Bean

formulating a report and recommendations in accordance with which a program for the improvement of the property was undertaken. Mr. Bean in particular covered matters relating to mechanical department facilities, new power, etc. Subsequently it has been largely in accordance with his recommendations and plans that the very large number of improvements for affording the mechanical department better facilities have been carried out and the large purchases of new locomotives have been made.

KENNETH CARTWRIGHT has been appointed assistant mechanical engineer in charge of specifications, designs, records and standards of equipment of the New York, New Haven & Hartford. Mr. Cartwright was graduated from the Massachusetts Institute of Technology as a mechanical engineer in 1912. He began his railroad career as a material inspector for the New Haven in June, 1914. In June, 1918, he left the railroad to become a junior lieutenant in the Navy. He returned to the railroad in February, 1920, as assistant to the engineer of tests and general mechanical inspector. On May 16, 1924, he was appointed chief mechanical inspector, which position he held until his recent appointment.

Pennsylvania combines two regions

On June 1 the operations of the Pennsylvania in the Northwestern and Southwestern regions of the system were combined for the purpose of obtaining the advantages of a more concentrated administration of the service and the facilities in the territory affected. The consolidated region is known as the Western region.

R. G. BENNETT, who recently was appointed general superintendent of motive power, Southwestern region, is now general superintendent of motive power, Eastern region, with headquarters at Philadelphia, Pa.

J. M. HENRY has been appointed assistant chief of motive power —locomotives—on the staff of the chief of motive power of the Pennsylvania system. Mr. Henry was born on October 10, 1873, at Altoona, Pa. He entered the service of the Pennsylvania as a special apprentice in the Altoona machine shops in May, 1889, and served as an apprentice until September 1, 1896, when he entered Purdue University, being furloughed from the shops during the school term each year. He was graduated in June, 1900, and then became a special apprentice in the office of the assistant engineer of motive power at Altoona. A year later he was promoted to motive power inspector at Altoona, and in February, 1902, became assistant engineer of motive power of the Erie division and Northern Central Railway at Williamsport, Pa. From July 1, 1903, to December, 1913, he was master mechanic at various shops. On the latter date he was promoted to superintendent of motive power of the Western Pennsylvania division, and on May 1, 1916, was transferred to the operating department as assistant superintendent of the Pittsburgh division. In April, 1917, he was transferred to the New York division, and in October of the same year he was appointed assistant general superintendent of motive power at Altoona. On March 1, 1920, he was appointed one of the four regional general superintendents of motive power, which position he held until his recent promotion.


J. M. Henry

F. L. CARSON, mechanical superintendent of the San Antonio & Aransas Pass, has been promoted to assistant superintendent motive power and equipment of the Southern Pacific, lines in Texas, with headquarters at Yoakum, Tex. Mr. Carson was born on February 23, 1871, at Oakland, Cal. He entered railway service in 1890 as an apprentice in the mechanical department of the Atchison, Topeka & Santa Fe and was promoted to erecting foreman in 1895. He was promoted to roundhouse foreman in 1897 and to general foreman at Cleburne, Tex., in 1900. Mr. Carson was promoted to master mechanic of the Northern division in 1901, where he remained until 1905, when he was appointed master mechanic of the El Paso & Southwestern, now a part of the Southern Pacific. Two years later he was appointed master mechanic of the Mexican Central, where he remained until 1909, when he resigned to become superintendent of machinery of a mining company. Mr. Carson returned to railway service in 1912 as master mechanic of the Chicago Great Western. Later in that year he was appointed master mechanic of the San Antonio & Aransas Pass, with headquarters at Yoakum, Tex., in which position he remained until November, 1914, when he was promoted to superintendent of motive power. His recent appointment as assistant superintendent of motive power and equipment of the Southern Pacific, lines in Texas, is the result of the consolidation of the San Antonio & Aransas Pass with the Southern Pacific lines.

A. MCDONALD has been appointed acting superintendent of motive power of the shops of the Canadian National at Montreal, Que., succeeding G. M. Wilson, who has been assigned to other duties.

J. T. CARROLL, general superintendent motive power of the Baltimore & Ohio at Baltimore, Md., has been appointed general superintendent motive power and equipment, with the same headquarters.

Car Department

R. PRICE has been appointed car foreman of the Black Hills division of the Chicago & Northwestern, with headquarters at Chadron, Neb., succeeding E. R. Phillips.

J. J. TATUM, superintendent car department of the Baltimore & Ohio at Baltimore, Md., has been appointed general superintendent car department, with the same headquarters.

Master Mechanics and Road Foremen

JOHN T. GROW has been appointed district master car builder of the New York Central, with headquarters at Albany, N. Y., succeeding G. E. Carson, retired. Mr. Grow was born on March 30, 1887, at Buffalo, N. Y., and was later graduated from the Masten Park High School, Buffalo, N. Y. He entered railway service on September 6, 1904, as a laborer in the planing mill of the East Buffalo Car Shops of the New York Central. In 1907, he was promoted to mechanic, and in 1908, to piecework inspector. He became foreman at Corning, N. Y., in 1912, and held this position until 1915, when he was transferred as foreman to Clearfield, Pa. From 1917 to 1923, he was assistant shop superintendent at Avis, Pa., and at that time became assistant district master car builder at Albany, N. Y., which position he held at the time of his recent appointment.


John T. Grow

J. E. FRELS, master mechanic of the San Antonio & Aransas Pass, at Yoakum, Tex., has been appointed master mechanic of the Southern Pacific, with the same headquarters.

E. R. PHILLIPS has been appointed general car foreman of the Iowa division of the Chicago & Northwestern, with headquarters at Council Bluffs, Iowa, succeeding H. W. Hanson.

P. L. LAIRD has been appointed general car foreman of the Madison division of the Chicago & Northwestern, with headquarters at New Butler, Wis., succeeding H. Bentson.

W. H. STEMPLE has been appointed general car foreman of the Iowa and Minnesota division of the Chicago & Northwestern, with headquarters at Belle Plaine, Iowa, succeeding R. Price.

H. BENTSON has been appointed general car foreman of the

Wisconsin division of the Chicago & Northwestern, with headquarters at (Chase Yards) Allis, Wis., succeeding J. C. Byrne.

H. W. Hanson has been appointed district master car builder of the Iowa and Minnesota, Northern Iowa and Sioux City divisions of the Chicago & Northwestern, with headquarters at Boone, Iowa.

C. C. Nash has been appointed district master car builder of the Madison, Minnesota and Dakota divisions of the Chicago & Northwestern, with headquarters at Winona, Minn., succeeding H. Marsh.

J. W. Dunning has been promoted to general foreman car repairs of the Southern, with headquarters at Columbia, S. C. It was incorrectly stated in the May issue of the *Railway Mechanical Engineer,* under the shop and enginehouse personals, that G. W. Dunning had been promoted to general foreman of the Southern.

Shop and Enginehouse

C. H. Hartland has been appointed assistant foreman of the boiler shop of the Pennsylvania, with headquarters at Renovo, Pa.

A. C. Reeves, erecting shop foreman of the West locomotive shops of the St. Louis-San Francisco at Springfield, Mo., has been promoted to general foreman, succeeding H. J. Ray.

E. L. Iotte, night roundhouse foreman of the Chicago, Milwaukee & St. Paul at Janesville, Wis., has been promoted to day roundhouse foreman, with headquarters at Madison, Wis.

G. T. Goddard, formerly general electrical foreman in the Burnside shops of the Illinois Central, has been appointed equipment inspector of the Chicago terminal improvement department.

H. R. Seaman, gang foreman of the West locomotive shops of the St. Louis-San Francisco at Springfield, Mo., has been promoted to erecting shop foreman, succeeding A. C. Reeves.

P. J. Colligan, superintendent of motive power of the Second district of the Chicago, Rock Island & Pacific, with headquarters at El Reno, Okla., has been appointed superintendent of shops at Silvis, Ill., succeeding S. W. Mullinix, deceased.

H. J. Ray, general foreman of the West locomotive shops of the St. Louis-San Francisco at Springfield, Mo., has been appointed shop superintendent of the North locomotive shops, succeeding J. W. Surles, who has been granted a leave of absence.

Purchasing and Stores

C. J. Pearce has been appointed division storekeeper of the Shasta division of the Southern Pacific, with headquarters at Dunsmuir, Cal.

W. E. Lefaivre, purchasing agent of the Denver & Rio Grande Western, at Denver, Colo., has been appointed general storekeeper, with the same headquarters.

D. C. Curtis, general storekeeper, lines east, of the Chicago, Milwaukee & St. Paul, at Milwaukee, Wis., has been promoted to chief purchasing officer, with headquarters at Chicago.

G. M. Betterton, chief clerk in the purchasing department of the Southern Pacific at San Francisco, Cal., has been promoted to assistant purchasing agent, with the same headquarters. This is a newly created position.

Obituary

C. A. Wirth, master mechanic on the Northern Pacific, with headquarters at Pasco, Wash., died in that city on June 1.

David W. Ross, formerly purchasing agent and later general superintendent of transportation of the Illinois Central, who left railway service in June, 1905, died in New York on June 10.

George L. Potter, formerly third vice-president of the Baltimore & Ohio, died on May 31 at his home near Baltimore, Md. Mr. Potter was born on December 28, 1856, at Bellefonte, Pa., and entered railway service in 1876 as a machinist apprentice on the Pennsylvania. From 1880 to 1882 he was a machinist for this company at Renovo, Pa., and from the latter date to 1887, assistant master mechanic at Fort Wayne, Ind. From 1887 to 1893 he was master mechanic at the same point, and in the latter year was promoted to superintendent of motive power of the Northwest System, Pennsylvania Lines West. From 1899 to 1901 he was general superintendent of motive power. He was then appointed general manager of the Lines West, but resigned that position a few months thereafter to become general manager of the Baltimore & Ohio. In 1903 he was elected third vice-president of the latter road, and served until 1910, when he resigned.

Warren S. Stone, president of the Brotherhood of Locomotive Engineers and of its various banking, investment and industrial enterprises, died in a hospital at Cleveland, Ohio, on June 12, from an acute attack of Bright's disease. Mr. Stone was born on a farm near Ainsworth, Iowa, on February 1, 1860, and entered railway service in 1879 as a locomotive fireman on the Chicago, Rock Island & Pacific at Eldon, Iowa. Five years later he was promoted to engineman and, in 1903, after having served in this capacity for almost 20 years, he became grand chief engineer of the Brotherhood of Locomotive Engineers. Recently, with the multiplication of the organization's financial and industrial undertakings, a reorganization of the Brotherhood was brought about and Mr. Stone was elected president in general charge of all the union's activities, this leaving the labor activities to a newly elected grand chief engineer.

W. S. Stone

S. W. Mullinix, shop superintendent of the Chicago, Rock Island & Pacific, with headquarters at Silvis, Ill., died on June 12 in Moline, Ill., following a stroke of paralysis. Mr. Mullinix was born in Frederick County, Md., on May 12, 1859. He attended the public schools of Maryland and served an apprenticeship in the shops of the Baltimore & Ohio near Baltimore. Later he became machine shop foreman of the Chesapeake & Ohio at Huntington, W. Va. From Huntington he went to Louisville, Ky., and later to Paducah, Ky., as master mechanic of the Newport News & Mississippi Valley, now a part of the Illinois Central. After a brief period as enginehouse foreman of the Louisville & Nashville, at Louisville, he was appointed general foreman of the Central Vermont, at St. Albans, Vt. In 1903 Mr. Mullinix became master mechanic of the Kansas City Southern; in 1905, master mechanic of the Atchison, Topeka & Santa Fe at Raton, N. M., and in 1906 entered the employ of the Chicago, Rock Island & Pacific. In 1913 he was promoted to superintendent of the Silvis shops, previously having served as district mechanical superintendent at Topeka, Kan.

S. W. Mullinix

H. Englebright, who retired as master car repairer of the Southern Pacific in August, 1922, after a continuous service of 52 years with that road, died on June 5 at his home in Oakland, Cal., at the age of 73. Mr. Englebright entered the service of the old California Pacific as a blacksmith apprentice in 1869 and worked at this trade at various points until 1892, when he was appointed roundhouse and car foreman at Fresno, Cal. In 1898 he became general car foreman at San Francisco and in 1900 master car repairer at Oakland, which position he held until his retirement in 1922.

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When buying production machine tools

The present tendency to organize the facilities of the maintenance of equipment department with the primary objective of obtaining quantity production has led to the more general utilization of special purpose machine tools. Many of these machines are classified as distinctly special machines, but the majority of the special purpose machine tools used in railroad shops are standard types that have been equipped or converted for single-operation work. For example, there are many shops in which milling or planing machines are used solely for machining shoes and wedges; grinding machines for motion work pins, etc. In all probability an investigation would show such practices to be the rule rather than the exception. However, this development leads to a suggestion that many mechanical department officers and machine tool purchasing committees can do well to consider when about to purchase new machinery for specific jobs.

The ordinary machine tool, such as a lathe, planer or drill press is usually designed to perform a variety of jobs. Considerable extra equipment is sometimes included as part of the machine in order to make it adaptable to perform different kinds of work. However, if it is to be used for only one particular job, why buy the extra equipment? Again, there are many parts on a standard machine that could well be eliminated if it is to be used as a special purpose tool. It is in this connection that the machine tool salesman can be of real service in helping to reduce the cost if he is permitted to co-operate with the mechanical department officer or machine tool committee. Thus, instead of purchasing machine tools as equipped by the manufacturers, the railroad can purchase standard machines intended to be used on special jobs without acquiring a lot of parts which cannot be used. A saving on each machine which may amount to several hundred dollars in some cases, is well worth considering, especially if the road is placing a large order.

Getting Greater Firebox Life

One of the real problems confronting railroad mechanical departments at the present time is how to get greater life from locomotive boilers, particularly the fireboxes which are subject to the greatest temperature variations and hence expansion and contraction strains. Particularly in bad water districts, the deterioration of firebox sheets is rapid and in some cases necessitates the renewal of the entire firebox within a period of four years or perhaps less. This results in excessive cost of boiler maintenance work, both for labor and material, and possibly more serious still is the loss of the locomotive to revenue service during the period it is in the back shop for a new firebox.

In this connection the somewhat striking performance of a firebox on the Southern Pacific may be of interest. Locomotive 601, one of a lot of 10 Pacific type engines purchased from the Baldwin Locomotive Works in 1912 by the Southern Pacific Lines of Texas and Louisiana for passenger service between New Orleans, La., and Houston, Tex., was put in service in August, 1912, and, except for conditioning operations in back shop and enginehouse, has been in continuous operation since that date. The locomotive was last sent to the shop March 28, 1925, and at that time had been in service 12 years and 7 months with the original firebox, having run 1,130,880 actual miles, an average of 7,489 miles a month including the time in shop. The original firebox applied at the Baldwin Locomotive Works, was removed during March when the engine was held for general repairs.

The locomotive was in regular passenger service between New Orleans and Houston for over 10 years, and during the last two years hauled passenger trains in runs between New Orleans and San Antonio, Tex., a distance of 510 miles. The record of 1,130,880 miles run with the same firebox is unusual and indicates what can be done when proper attention is given to assure the frequent, thorough washing of locomotive boilers with hot water operation of locomotives in such a way as to minimize temperature variations under all conditions, and treatment of boiler feedwater to neutralize as far as possible its corrosive effect on firebox and other boiler sheets as well as the tubes and flues.

Accurate Costs and Business Management

In asking the Interstate Commerce Commission promptly to provide for the railroads a system of accounting which will currently and scientifically develop true costs for each primary and incidental activity in which they may engage, the seventeen representatives of the freight car repair industry who on July 14 addressed a communication to the members of the commission, have again brought into prominence a question which in one way or another has come up for discussion many times in the past. This question of cost accounting for the railroads is one with many ramifications and apparently involves a difference between the purposes of the standard form of accounts now in use by the railroads and the purposes of cost accounts which is not easy to compose. There are many difficulties in the way of a solution of this problem which will be ideal both from the standpoint of general railway accounting as well as from the standpoint of cost accounting. But it cannot be denied that there is sound reason back of the request made by the representatives of the car repair industry.

Cost accounting as it is applied in industry primarily provides the industrial executive with facts on which to

keep his production policy in proper relation to his market rather than with a means of controlling the costs themselves. Similarly, in the railroad shop, it is probable that accurate cost accounting would in most cases effect little difference in production control, for which some form of man-hour statistics are generally quite adequate. There are, however, business problems involving the policy of the railroad with respect to the purchase or manufacture of many types of material and supplies, in which costs carefully built up to include every item of overhead, such as carrying charges on the investment in buildings and equipment involved in the manufacture of the material in question, as well as superintendence and general expenses, are essential to the formulation of a sound decision. The argument that because buildings and machine tools are already available and the salaries of department and general officers must be paid, none of these items should be taken into account in figuring the cost of repairing cars and locomotives or the costs of secondary manufacturing operations, is carried too far. The fact seems to be overlooked that a blind following of this argument is likely to lead to a situation in which additions to these items become necessary because of the volume of the operations built up as a result of the fictitiously low prices at which the work can apparently be done by the railroad. Cases have been observed where in shops inadequate to meet the full demand for locomotive maintenance, building space and machine tool equipment have been devoted to whole departments actually engaged in the manufacture of machine tools for the use of the railroad, when such a policy could not possibly be justified by a comparison of costs if adequate overhead charges had been included in its own costs by the railroad. Even in the case of car repairs, the decision to make all repairs in the railroad's own shops because the expense for direct labor and material, plus shop expense, involved in doing the work in the company's own shop, is less than the contract price of the outside shop, must in the end lead to a heavy capital expenditure to provide adequate facilities to meet the maximum demand. In either of these cases it is evident that to neglect the various overhead expenses out of the calculation is fallacious.

In the interest of better business management in the establishment of equipment maintenance policies, it is evident that a compliance with the request of the representatives of the car repair industry is very much needed.

Making Better Foremen

We do not mean to imply from the title of this editorial that the foremen and supervisors in the mechanical department of American railroads have not made good. Too frequently they have been unjustly criticized. Even worse than this, foremen and supervisors who have gone to the very limit in promoting the interests of their employers, making great sacrifices of time and strength, have received not the slightest recognition or appreciation for such service. One marvels sometimes at the dogged persistence and loyalty that have characterized these men as a group, in spite of lack of recognition.

The managements, however, are in some cases open to the severest sort of censure not only because they have failed to recognize the loyalty and unselfish service of many of their foremen and supervisors, but also because they have failed to bring to the attention of these busy men the remarkable developments which have been made in recent years, in analyzing the principles of successful leadership and applying them in a scientific way. There is nothing much more spectacular or startling than the impressions made upon an average group of foremen in any industry when developments of this sort have been placed before them in a simple, understandable fashion. A notable instance of this on a railroad was the case of the Lehigh Valley foremen at the Sayre shops when they were introduced to the foremanship course developed by the Engineering Extension Department of The Pennsylvania State College. Almost as striking results have been evident when experts on management or foremanship training have appeared before other groups throughout the country either in the industries or on some of the few railroads which have attempted to face up to this problem. Incidentally some reference to a case of this kind is made in the comments elsewhere in this issue by "Output," on Bill Brown's prize article on "The Foreman and His Responsibility."

A few months ago we asked the mechanical superintendents on the different railroads for information concerning what, if anything, they were doing to promote foremanship training. The results of this investigation were summarized in the article on "Training Foremen in Leadership" which was published in our June number. One characteristic of a number of the letters received from the mechanical superintendents was the distinct request that they be fully advised of our findings—this request was so made in some cases that it indicated a real interest in the results of the study and a determination to take advantage of the good things which are being used on other railroads.

Since the publication of the article last June a number of developments have taken place which give great promise for the future in this matter of assisting the foremen and supervisors in improving their leadership ability. One mechanical superintendent, for instance, has appointed an assistant who will give his entire time to this question of training and coaching the foremen and otherwise helping to improve relations between the workers and the management. This assistant will not only receive thorough co-operation and encouragement from his immediate superior and the management in general, but will be furnished with such expert assistance as may be found desirable. Other mechanical department superintendents have indicated that they will assist the foremen and supervisors in every way possible, either through the formation of foremen's clubs for consideration of the principles underlying successful foremanship, or in the organization of study classes or other things which will be helpful to the foremen. Then, too, some of the groups which have been studying this problem have indicated a desire for information as to special topics for discussion which will assist them in carrying on their studies in a larger and more advanced way.

It is significant that several chief executives in looking over the June number of the *Railway Mechanical Engineer* specifically commented upon the first prize article on "The Foreman and His Responsibility" and the study or summary on "Training Foremen in Leadership." This should be a distinct encouragement to the mechanical department officers and foremen in going foreward with this good work. The *Railway Mechanical Engineer* is also interested in doing anything it can to be of assistance and to direct the studies and discussion along the right lines. Incidentally, in this connection we desire to direct special attention to the three rather interesting comments in this issue on the first prize article on "The Foreman and His Responsibility."

One of these comments is in the form of a very drastic criticism of Bill Brown's suggestions and philosophies. It comes from a man who apparently has very little sympathy with the modern tendency of the application of the Golden Rule to our industrial and transportation activi-

ties. We may designate him as of the "hard boiled" type, but nevertheless his attitude is that of a considerable number of foremen and supervisors in the mechanical departments of our railroads today. This must be clearly recognized and squarely faced, because the foremen are the very keystones in the mechanical department organization. This particular communication is signed "Top Sergeant" at the request of the writer of the article. Presumably he intends to reflect the so-called military attitude, although if we understand the new developments in the army of the United States, it is vastly different from that which is voiced by "Top Sergeant." Today the progressive leaders in the army apparently feel that the very highest morale can be engendered only when each man in the army is critically studied and then is so placed and developed that he can make the very best possible use of those particular talents with which he is endowed. Is it not true that the morale of a railway organization is also dependent upon helping the men to find that particular class of work for which they are best fitted and to assist them in so developing themselves that they can be of the greatest possible use and satisfaction both to themselves and the company for which they work—and in making this statement we do not mean to infer that the men should be exploited or worked beyond reasonable limits.

It will be noted that two of the comments on Bill Brown's article are in more or less agreement with Bill Brown, except that they emphasize or more fully dwell upon some of his suggestions. Closely related to these comments and forming a rather masterful discussion of the entire question of foremanship, is the presentation made by the winner of the second prize in the competition—John H. Linn, assistant supervisor of apprentices on the Santa Fe. It would be difficult to pack a greater amount of real information and inspiration on this foremanship question into so small a compass as occupied by Mr. Linn's discussion. Indeed, any group of ambitious foremen who will plan a series of discussions based on the two prize articles in this competition and the comments on Bill Brown's article in this issue, will find enough live topics to keep them going throughout an entire season.

Incidentally, we very greatly appreciate the co-operation given by those who have written to us about Bill Brown's article. The comments that we are publishing are thought-provoking and promise to be most helpful in encouraging foremen and supervisors to think this problem through to a logical conclusion. We wish we might have still more criticisms and comments. "Top Sergeant" has gone after Bill Brown in great shape, but Bill Brown is something of a fighter and years of practical experience and success as a foreman and shop superintendent have splendidly equipped him to support and back up his contentions. Could anything be more helpful to the foremen and supervisors in the mechanical department than a lively, straight-from-the-shoulder discussion of this question in our columns? We shall be glad to hear from any of our readers on either side of this question. The harder you hit, the better.

New Books

SUPERHEAT ENGINEERING DATA: *A handbook on the generation and use of superheated steam. Sixth edition, revised. Bound in keratol, 4½ in. by 7 in., 208 pages, 85 illustrations and diagrams, 69 tables. Published by the Superheater Company, New York. Price* $1.00.

This handbook contains condensed data for steam power plant engineers and operators. A feature of the book is the index consisting of 16 pages, which assures ready reference. Superheated steam, its advantages over saturated steam and the proper design and performance of superheaters, are briefly discussed. It illustrates superheater arrangements in practically all stationary, marine and locomotive type boilers commonly made in America. Waste heat, portable and separately fired superheaters are also shown. Brief comparative data is given as to sizes, tube sizes, arrangement of tubes, etc., for the stationary water tube boilers which are illustrated. The steam tables cover pressures from below atmospheric to 600 lb., absolute, and include properties of superheated steam from 50 deg. to 300 deg. F. superheat.

The section on piping includes information for figuring piping for handling water, saturated and superheated steam and velocity and pressure drop of water and steam flowing through piping. In this section is included the standard weights and pipe flanges for high pressures proposed by the American Engineering Standards Committee. This book also contains engineering data on coal and oil-fired boilers, which include tables of heat values for gaseous, liquid and solid fuels. Other miscellaneous data include complete conversion tables and data on bolts and screw threads, with the recent work of the American Engineering Standards Committee and the National Screw Thread Commission. There are also many miscellaneous tables frequently used by steam engineers.

What Our Readers Think

Minimum use of figures when setting Walschaert gear

PROCTOR, Minn.

TO THE EDITOR:

I have read with interest Mr. Sparrows' article which appeared on Page 77 on the February issue of the *Railway Mechanical Engineer* and do not feel content to sit on the side lines and let this article go by without a reply which he solicits. I agree that the fewer figures used the less liability there is for a mistake.

I will briefly outline the method of setting the Walschaert gear used on the Duluth, Missabe & Northern and approved by our officers. If the engine is to have new main crank pins they are turned and milled with the proper size key-way on the eccentric crank fit of the pin. They are then placed on a face plate shown in Fig. 1, with the two centers leveled up. We have a templet, Fig. 2, for each class of engines, *A C* being made equal to one-half of the crank pin throw, *A B* equal to the length of the eccentric crank arm and *B C* equal to one-half of the eccentric throw circles. With the side *A C* of the templet resting on the face-plate the pin is turned until the center of the pin and the center of the key-way line up with the side *A B* as shown in Fig. 1. Then with a surface gage set to the center of the pin, the line *x y* is scribed on the side of the pin at the back end. When pressing the pin in the hole, the line *x y* on the pin should register with the line *x, y,* on the wheel as shown in Fig. 3. One side of this templet is placed outward for right pins and the opposite side placed outward for left pins. Care should be taken to use it properly and it should be marked to avoid confusion.

The next operation is the setting of the crank arm to the proper throw by the use of the gage shown in Fig. 4, drill and ream the hole for the bolt and fit the key. All motion parts should be checked to see if they compare with the drawings.

The first procedure in setting valves, after getting the port marks and dead centers, is to check the suspension of

the radius bars. The reverse lever is placed so that, the link block on one side is exactly in the center of the link. This can be checked by moving the link forward and back with the eccentric rod disconnected and noting when no motion is conveyed to the valve. The other side should now be examined to see if it is exactly central which, if not, indicates that the length of the radius bar hanger must be altered. To ascertain the amount of alteration required, first tram the lifter arm from some stationary

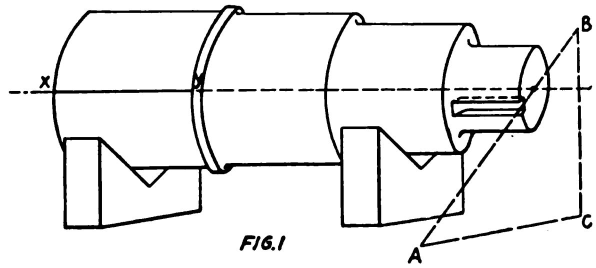


FIG. 1

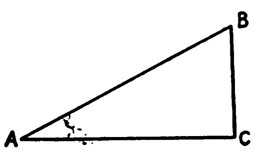


FIG. 2

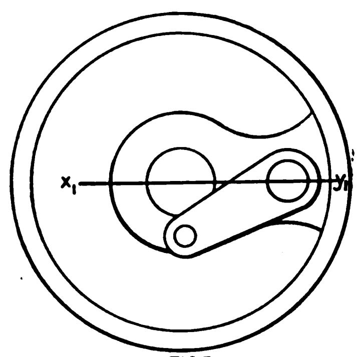


FIG. 3

Fig. 1—Crank pin placed on the face plate preparatory to laying off key-way; Fig. 2—The templet used for each class of locomotive; Fig. 3—Line X Y on the pin should register with line X_1 Y_1 on the wheel when pressing in the pin

point either directly above or directly below it then move the reverse arm until a perfectly still valve is found when rocking the link. Then tram the lifter arm again from the same point with the same tram. The distance between the two tram marks denotes the change required on one hanger in order to have both link blocks centered at the same time. Nothing else preventing, the short hanger may be lengthened this amount.

The following method is used to get the proper length of the valve stem and eccentric rod. With the reverse lever in the position that will exactly center the link blocks, revolve the main wheels and mark the extreme travel of the valve upon the valve stem. The port opening obtained at each end is the lead of the valve and if the leads are not equal the valve stem should be altered one-half the difference. We do not make a practice of changing the length of the radius bar. The change is made on the valve stem by pulling the valve out of the chamber and facing the collar or applying a faced washer between the spider and the collar as the case demands. It must be remembered that new port marks have to be taken when the valve is replaced.

Let it now be said that the valve stem is the proper length. Our attention will be now on the eccentric rod.

Placing one side of the locomotive on dead center the link should be exactly plumb and moving the link block from one end of the link to the other should not move the valve. If the valve moves, it indicates that the link is not plumb, as shown by the dotted lines in Fig. 5. The eccentric rod must be altered to make it plumb. Tram from the foot of the link to the guide yoke as at *a*, then revolve the main wheels slightly to plumb the link. (By moving the link block from one end of the link to the other, the link is known to be plumb when no motion is conveyed to the valve.) After the link is plumb tram again as at *b*. The difference between *a* and *b* is the amount necessary to alter the length of the eccentric rod. The same method applies on the other side of the locomotive.

The leads of the valves are now square. It is a known fact that the points of cut-off are not always square with the leads.

10	10½
10	10½

Fig. 6

If the cut-offs in the running position show up as shown in Fig. 6 it indicates a valve rod change to square up the valve. The amount of change is determined in the following manner. Return to the shortest cut-off point, in this case 10 in., from the back end of the stroke, and the tram falls in the port mark on the valve stem. Revolve the wheels until the crosshead is 10¼ in. $\left(\frac{10 + 10\frac{1}{2}}{2}\right)$ from the back end of the stroke and tram again on the valve stem. To square the cut-off the valve rod should be changed a sufficient amount to bring the port mark under the tram at this position.

10½	10
10	10½

Fig. 7

If the cut-off in the running position shows up as in Fig. 7 it would be necessary to make a slight eccentric rod change to square up. The amount of change may be

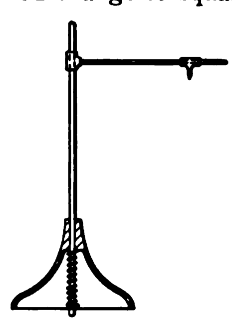


FIG. 4

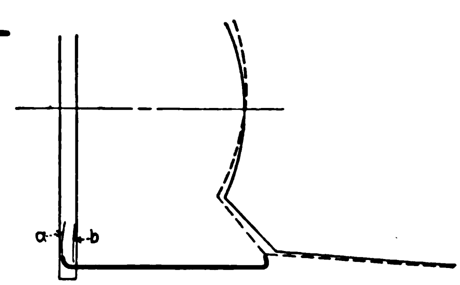


FIG. 5

Fig. 4—Gage used when setting the crank arm to the proper throw; Fig. 5—Method of training a link to make it plumb

determined in the following manner. With the reverse lever remaining in the forward position and in the same notch as when the cut-off was taken, return to the short cut-off, 10 in. from the front end of the stroke and tram from the foot of the link to the guide yoke. Revolve the wheels until the crosshead is 10¼ in. $\left(\frac{10\frac{1}{2} + 10}{2}\right)$ from the front end of the stroke and tram again from the foot of the link to the guide yoke. The eccentric rod should be altered the amount between the two tram marks to square the cut-off. The last two changes, if made, will of course make a variation in the leads and one must be conservative in making changes, not go to the extremes.

T. C. GUMMERSON,
Supervisor of valve motion, D. M. & N.

The evaporative capacity of locomotive boilers

A new formula is proposed for determining the relationship between the rate of evaporation and the rate of combustion

By Alexander P. Poperev

Part I

AMONG the different problems of railway mechanical engineering yet waiting a satisfactory solution, is that of accurately predetermining the evaporative capacity of the locomotive boiler for any given set of conditions. When we take into consideration the fact that it is the boiler rather than the engine, which determines and limits the capacity of the locomotive, it will be understood why an accurate solution of this problem is so important to the railroads as well as to the locomotive builders.

The present method of handling this problem is far from being commensurate with its importance, at least as far as its accuracy is concerned. Various cut and dry rules commonly used that are derived from practice, are too general and do not go further than to give a rough idea about the usual proportionality between dimensions of the boiler and the tractive force of the locomotive. Likewise, from experience we know approximately how much steam can be produced under average conditions by the unit heating surface of the locomotive boiler. Nevertheless, with all the years of experience and knowledge, when it comes down to the question, "given a certain locomotive and fuel, how much steam can be produced at a certain rate of combustion?"—one has either to guess or run an experiment. However, it is just this question that both the railroads and the locomotive builders would like very much to have answered.

An intelligent and accurate answer to this question evidently requires the knowledge of a general law, governing the relationship between the evaporative capacity of the locomotive boiler and the various factors affecting it. Neither a theoretical nor experimental study of the question, however voluminous it may be, has as yet given a general mathematical expression of the above law. The problem is far too complicated. However, there has been accumulated a considerable amount of experimental data, which permits the study of the influence of various factors, at least the most important ones, as to the evaporative capacity of the locomotive boiler.

The writer has been interested in this question for some time and he aims in this article to discuss certain results of a personal study covering a considerable period of time. Considering the performance of the locomotive boiler to be entirely independent from the engine and subject to its own particular laws, it has been found possible, from available experimental data, to arrive at certain formulas, purporting to express the relationship between the evaporative capacity of the locomotive boiler and some of the most influential factors affecting it. The resulting expressions cover a sufficiently wide range of conditions, as much as available experimental data would permit, and are fairly accurate. In order to avoid the inconvenience of using a somewhat complicated and unwieldy resulting formula, the construction of a diagram is worked out, whereby necessary computations may be made graphically in a very simple manner.

While the suggested expressions, being dependent upon the available experimental data, are not to be considered as final ones and refer only to a certain range of conditions, it is believed that they will be of some interest to the engineering profession, as they are even at this stage of development fairly applicable in practice, and a somewhat different method of their derivation offers a wide field for further experimental study and research.

THE author of this article, Alexander P. Poperev, is a Russian engineer. For a considerable period of time he was associated with Prof. G. V. Lomonossoff as a testing and research engineer in the experimental study of locomotives for the Russian State Railways where the idea of deducing the general equation described in this article for determining the capacity of locomotives was originated. He received his education at the Polytechnical Institute at Petrograd and is also a graduate of Massachusetts Institute of Technology.

Factors determining the capacity of the boiler

Even an elementary study of the performance of the locomotive boiler shows that there are a considerable number of factors which determine its evaporative capacity. A general analysis and experimental study leads to the conclusion that the following three factors may be considered as the most important ones; namely, type and dimensions of the boiler, kind and quality of fuel, and the rate of combustion.

The effect of other factors appears to be comparatively small. For the sake of simplicity, we may, therefore, neglect them without serious error and to assume, as a first approximation, that the capacity of the locomotive boiler is determined by the above three factors only. This assumption, as we shall presently see, is sufficiently accurate for average practical purposes.

Our next problem will then consist of determining the

relationship between the capacity of the boiler and these factors and finding for it a suitable mathematical expression. As the theory is not yet sufficiently developed to derive it in a purely analytical way, we will have to derive it empirically from available experimental data. Luckily, available experimental data permits at least to a certain extent, the analysis of the influence of each factor separately and to express it by a formula. We shall begin with a study of the relationship between the capacity of the boiler and the rate of combustion.

Relationship between the capacity of the boiler and the rate of combustion

It was noticed long ago that the rate at which fuel is burned has a marked effect upon the rate at which steam is produced by the boiler, and that there exists a definite relationship between the two. For some reason difficult to understand, this most important relationship has not been given the attention it rightfully deserves, and as we shall presently see, there has not been suggested, as yet, a general formula for this relationship which could account for all the characteristic properties and be considered as correct.

In this article the evaporative capacity of the boiler is referred to as the equivalent rate of evaporation (pounds of steam, produced at and from 212 deg. F. by one sq. ft. of heating surface, per hour) as this form lends itself conveniently for comparative analysis of the performance of boilers with different characteristics. The rate of combustion is expressed in pounds of dry fuel, burned per sq. ft. of grate area per hour. If the values of the rate of evaporation Z are plotted as ordinates against the corresponding values of the rate of combustion Y as abscissae, a smooth curve will be obtained, which graphically represents the relationship between the values of Z and Y. Such curves are presented in a way of illustration in Fig. 1, and the first thing which attracts our attention is that while they refer to most diversified boilers and fuels, yet the general shape of all the curves is manifestly the same.

It has been found, by checking with all available experimental data, that curves of a similar character are invariably obtained for any kind of boiler and fuel which leads us to the conclusion, and a very important one, that the rate of evaporation varies with the rate of combustion according to some general law. Let us then see by what kind of formula we could express the relationship between these factors. We shall approach this question by analyzing a few formulas suggested by various investigators and at the same time endeavor to learn some of the characteristic properties of this important relationship.

The straight line formula

That the relationship between Z and Y cannot be correctly expressed by a straight line equation is quite evident directly from the plots. However, many investigators still believe it to be sufficiently correct, but it is perhaps worth while to show that it is not true even for rough approximation. First of all the straight line formula necessarily assumes that for any given boiler and fuel, the proportion of losses in a boiler is constant and independent of the rate of combustion. This is not true, and as we shall see later, the experiments show quite definitely that the losses increase and rather rapidly with the rate of combustion, particularly in the locomotive boiler. But the best way to show its fallacy is in a purely algebraic way. Usually this equation is quoted in the following general form:

$$(1) \quad Z = a + bY$$

where Z and Y represent, as before, the rates of evaporation and combustion respectively, and a and b are certain positive constants for a given boiler and fuel. Now, suppose $Y = O$; we then come to an absurd conclusion, that when no fuel is burned at all, the rate of evaporation, according to this formula, is still a definite quantity equal a, which is evidently impossible.

The Dr. Goss formula

At sufficiently high rates of combustion, the Z-Y curve deviates considerably from the straight line, which plainly indicates that its equation must necessarily be of higher order than the first. Based upon his well known experiments with locomotives, Dr. Goss suggested the

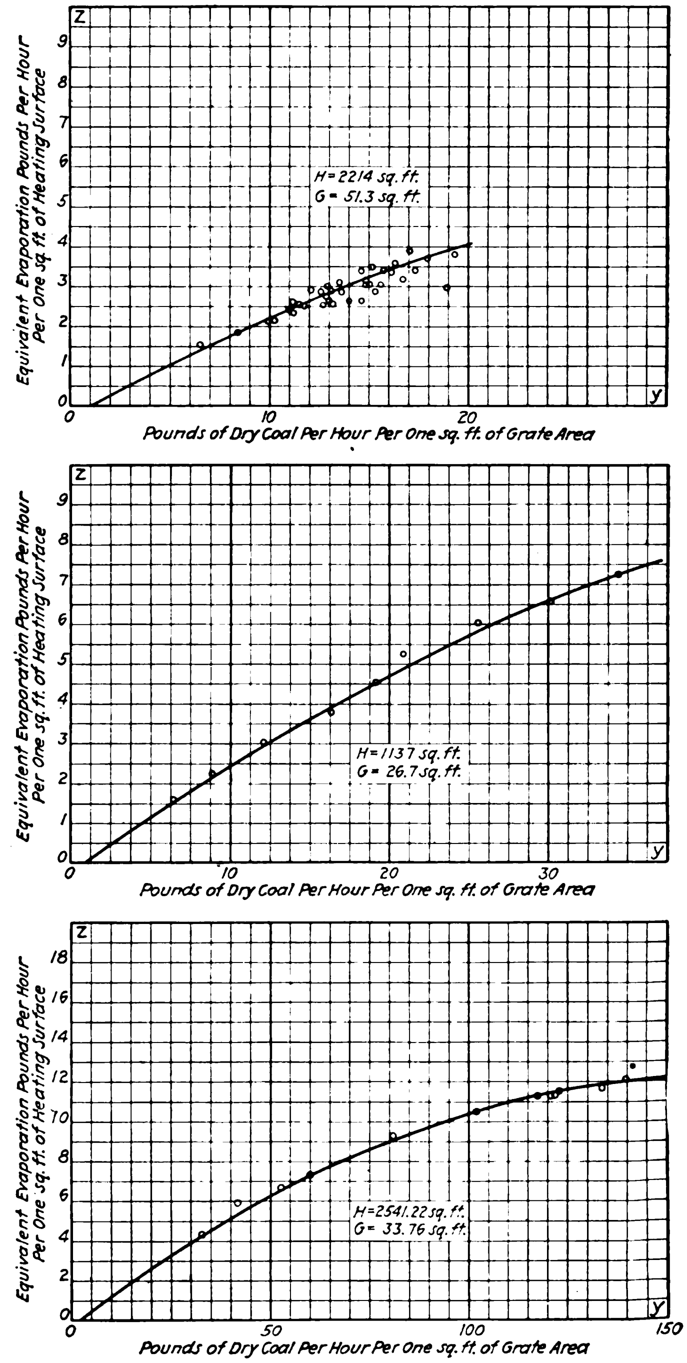


Fig. 1—Top chart, tests made on a Babcock & Wilcox boiler at the Massachusetts Institute of Technology; Center chart, Whitman's tests on a horizontal return tubular boiler; Bottom chart, Pennsylvania Railroad Company tests on a locomotive boiler

following expression for the relationship between the capacity of a boiler and the rate of combustion.[1]

$$(2) \quad C = \frac{W}{a - bW} \text{ in which}$$

C = the total amount of fuel consumed per hour, lb.
W = the corresponding total amount of steam produced, lb.
a and b are constants.

This expression was not obtained directly, but was derived from the relationship between the evaporation per pound of fuel E, and the rate of evaporation per square foot of heating surface H. After a careful selection of corresponding experimental data, Dr. Goss assumed, that the relationship between E and H can be sufficiently correctly expressed by the linear equation

$$(3) \quad E = a - b_1 H$$

where a and b_1 are certain positive constants for a given boiler and fuel. E and H can also be expressed through

$$E = \frac{W}{C}$$

and

$$H = \frac{W}{S}$$

where S is the total amount of heating surface of the boiler.

Equation (2) was obtained by substituting in equation (3) the above values of E and H. By plotting equation (2) it was found, that although it was derived in a somewhat indirect manner, nevertheless it did fit well the values of C and W obtained directly by experiment. This fact was considered as a sufficient proof that equation (2) is correct and has been endorsed since then by other investigators[2]. However, this is not always the case, and it is possible to show that equation (2) does not represent the relationship correctly.

Rewriting equation (2) in a somewhat different manner

$$(2a) \quad \ldots\ldots\ldots\ldots \quad W = \frac{aC}{1 + bC} = \frac{a}{b + \frac{1}{C}}$$

it can be readily seen that according to the equation, the value of W steadily increases with the rate of combustion C and reaches its limiting value $\frac{a}{b}$ at an indefinitely large value of rate of combustion, $C = \infty$. This fact is not substantiated by experiment. On the contrary, experiments show[3] quite clearly that the maximum rate of evaporation occurs at certain definite, and not indefinitely large rates of combustion and after reaching it, it has a marked tendency to decrease, notwithstanding the fact that the rate of combustion continues to increase. Such a behavior of the Z-Y curve can be readily explained by the fact, that various losses in a locomotive boiler increase very rapidly with the rate of combustion. For instance, loss due to sparks and cinders increases nearly as the square of the rate of combustion as it has been found by Dr. Goss's experiments.[4] It is evident, that at such an extensive rate of increase, the effect of this loss alone can check a further increase in the rate of evaporation and then force it down.

On the other hand, from equation (2) it follows that if $C = O$, then $W = O$ also. It would be so if we had had an ideal boiler, with no losses whatsoever; but in an actual boiler certain losses are always present, so that evaporation actually does not start until the rate of combustion reaches a certain value Y_o, usually rather small, at which the heat developed by the fuel is just enough to cover various heat losses. The value of Y_o, that is the minimum rate of combustion, necessary to keep the boiler in thermal balance, and which corresponds to a zero rate of evaporation, is very easily determined by experiment, by firing the boiler just enough to keep the pressure constant with all the steam shut off and measuring the amount of fuel consumed. Its importance for correct shaping of the Z-Y curve can be readily appreciated, and in tests made by the Russian State Railways, this experiment constituted a regular part of the test program for each locomotive.

It is also evident, that when the rate of combustion is smaller than Y_o, the heat developed by the boiler will not be sufficient to make up various heat losses; the thermal balance will be disturbed, and the boiler will cool off; in other words, at values $Y < Y_o$ we will have negative rate of evaporation. It follows, therefore, that when no fuel is burned at all, that is when $Y = O$, the correct formula for the relationship between Z and Y should give a certain negative value Z_o for the rate of evaporation which will represent the aggregate value of heat losses, when no outside heat is supplied to the boiler. We see, that equation (2) also fails to satisfy this condition. After all, the fundamental equation (3) from which equation (2) was derived, is not correct by itself. When $H = O$ from equation (3), it follows that $E = a$, which is obviously wrong. Thus we see, that from the above considerations Dr. Goss's formula fails to represent correctly the relationship between the capacity of the boiler and the rate of combustion.

Lawford H. Fry's formula

An empirical formula for the relationship between the rate of combustion was also suggested recently by Lawford H. Fry[5] which he developed in a manner similar to Dr. Goss; only in this case a linear relationship was assumed between the efficiency of the boiler F and the rate of combustion G. This relationship, according to Mr. Fry, can be expressed as follows:

$$(4) \quad \ldots\ldots\ldots\ldots \quad F = m - nG$$

where m and n are certain constants for a given boiler and fuel. From a general definition of the efficiency of a boiler

$$\text{Efficiency} = \frac{\text{Heat utilized}}{\text{Heat consumed}} = \frac{WSk}{GRK} \times 100 = m - nG$$

he obtains

$$(5) \quad \ldots\ldots\ldots\ldots \quad W = \frac{nG - nG^2}{K_oC}$$

where

$$C = \frac{\text{Heating surface}}{\text{Grate area}} = \frac{S}{G}$$

W = the rate of evaporation, lb. per sq. ft. of heating surface.
K = the heating value of fuel in B.t.u. per lb.
k = the heat in B.t.u. required to produce 1 lb. of steam from feed-water.

$$k_o = \frac{100}{K}$$

The above formula (5) suggested by Mr. Fry, fits the experimental data quite well, as it can be seen from diagrams, presented by Mr. Fry.[6] Besides, it accounts for the existence of a maximum rate of evaporation corresponding to a certain definite rate of combustion and from this point of view this formula is undoubtedly more correct than the one suggested by Dr. Goss.

Nevertheless, there are convincing reasons for doubting the correctness of the method, accepted by Mr. Fry,

[1] Locomotive Performance, by Dr. W. F. Goss, p. 151.
[2] Transactions, American Society of Mechanical Engineers, Volume XXII, p. 490; Proceedings, Institute of Mechanical Engineers (London) 1908, p. 269.
[3] The Engineer (London), 1920, p. 327.
[4] Engineering (London), 1913, pp. 485, 564.
[5] Engineering (London), 1921, p. 125. A Study of the Locomotive Boiler by Lawford H. Fry, p. 46.
[6] A Study of the Locomotive Boiler by Lawford H. Fry, p. 105.

for derivation of his formula and incidentally, the correctness of the formula itself. Mr. Fry does not advance any reason for the assumption of a straight line relationship between the efficiency of a boiler and the rate of combustion, except the statement that the straight line fits experimental data fairly well. But the analysis of the performance of a boiler brings us to a conclusion that the efficiency of a boiler varies with the rate of combustion according to a more complex law than the linear. We have seen that at a certain rather small value of the rate of combustion Y_0, the rate of evaporation is zero, as all the heat developed is taken up upon covering the various heat losses. The efficiency of the boiler, corresponding to this rate of combustion Y_0 is evidently zero. With the increase of the rate of combustion, the effect of the losses, which are constant and independent from the rate of combustion, that is radiation losses, leaks, etc., rapidly decreases. On the contrary, the effect of losses, proportional to the rate of combustion, rapidly increases.

At a certain value of rate of combustion these two opposing factors balance each other. The proportional loss of heat at this point will be minimum and the efficiency of the boiler will have its maximum value. In other words, the general considerations lead to a conclusion that the curve, representing the variation of the efficiency of a boiler with the rate of combustion, can not be a straight line, but must be of a higher order. The experience of Babcock & Wilcox Company[7] seems to prove that with sufficient evidence, and, on the other hand, as the writer showed some time ago, that this relationship can be satisfactorily expressed by an equation of a second order.[8] Again, the basic formula (4) contradicts the general definition of the efficiency of a boiler as quoted above. At zero rate of combustion, the efficiency of a boiler evidently can not have a maximum or any definite value. Finally, the formula (5), suggested by Mr. Fry, gives for the zero rate of combustion the value of the rate of evaporation equal to zero also, while, as we have seen, it should be negative. The above considerations seem to be sufficient to consider Mr. Fry's formula (5) and his method of derivation as also failing to express correctly the relationship between the evaporative capacity of a boiler and the rate of combustion.

Characteristic properties of the relationship between the evaporative capacity of the locomotive boiler and the rate of combustion

Let us summarize the various characteristic properties of this important relationship which we have found by analyzing different expressions for it. We have found that:

a—The general character of the curve, representng this relationship is the same for any type of boiler or kind of fuel; i.e., it is independent from both these factors.

b—It has a maximum at a certain definite, and not indefinite rate of combustion.

c—At the zero rate of combustion, the rate of evaporation is not zero, but is a certain negative quantity, equivalent to the aggregate heat losses of the boiler.

As we have seen, neither of the suggested formulas for this relationship could account for all of the enumerated characteristic properties of this relationship and for that reason, neither of them can be considered as a sufficiently correct expression of it. This failure can be largely attributed to a somewhat incorrect method of deriving these formulas; namely, from some secondary relationships, instead of utilizing original values of Z and Y, obtained directly from experiment. We hardly can agree with Mr. Fry, that such an indirect method is the best. It would be so if the secondary relationships were very simple or their properties were well known. Such is not the case and consequently the reverse method of procedure, namely finding at first a general expression of the basic relationship between Z and Y directly from original experimental data, would seem to be more rational, as then all the secondary relationships between the rate of combustion and efficiency, etc., can be derived easily in a purely algebraic way. Such a method of procedure has been adopted by the writer.

Expression suggested by the author and its analysis

Quite sometime ago,[9] the author suggested the following general formula to express the relationship between the rate of evaporation and the rate of combustion:

$$(6) \quad Z = -a + bY - cY^2$$

where

Z = the rate of evaporation, in pounds per sq. ft. of heating surface per hour.
Y = the rate of combustion in pounds per sq. ft. of grate area per hour.
a, b and c = co-efficients, which are constant, for a given boiler and fuel. In general they are functions of both these factors.

This expression was tried by the author on all available experimental data referring to both stationary and locomotive boilers and in every case, without exception, it was found, that formula (6) fits the experimental data in a satisfactory manner.

Let us now check its correctness by applying to it an analysis similar to the above. At the rate of combustion equal zero, $Y = O$, the rate of evaporation, according to formula (6), is negative, that is $Z = -a$. As we have seen from the above, it is one of the characteristic properties of the relationship between Z and Y and is accounted for by the suggested formula.

With the increase of the rate of combustion, the rate of evaporation steadily increases until it reaches its maximum value, which, according to the formula (6), is

$$(7) \quad Z_{max} = -a + \frac{b^2}{4c}$$

which occurs at the rate of combustion equal to

$$(8) \quad Y_{z=max} = \frac{b}{2c}$$

The expressions (7) and (8) are found by equating the first derivative of the formula (6) to zero and solving for Z and Y. As the coefficients b and c are always definite positive quantities, the value of $Y_{z=max}$ will be definite also.

Significance of the coefficients of the formula (6) and its graphical representation

It is interesting to note that although formula (6) is purely empirical, its terms nevertheless can be ascribed as having a definite physical significance. Let K represent the heating value of one pound of fuel and r equal the heat necessary to produce one pound of steam. If G and H will denote respectively the values of the grate area and the heating surface, then the maximum theoretically possible value of the rate of evaporation at the rate of combustion y will be

$$Z_{theor.} = \frac{KGy}{Hr}$$

For any given boiler and fuel, the coefficient b in the expression (6), as well as the ratio $\frac{KG}{Hr}$ are constants.

[7] Steam. Babcock & Wilcox Company, 35th edition, page 284.

[8] Engineering Messenger (Petrograd), 1915, No. 23. A note on the question of the relationship between the efficiency of the locomotive boiler and the rate of combustion, by A. Poperev.

[9] Engineering Messenger (Petrograd), 1915, No. 23. A note on the question of the relationship between the efficiency of the locomotive boiler and the rate of combustion by A. Poperev.

Therefore, it will be entirely correct to express the value of the coefficient b in the following manner:

$$b = \frac{KG}{Hr} - n$$

where n is a certain yet unknown constant.

Substituting this value of b into expression (6), we have:

$$\begin{aligned} Z &= -a + bY - cY^2 \\ &= -a + \left(\frac{KG}{Hr} - n\right) Y - cY^2 \\ &= \frac{KG}{Hr} Y - (a + nY + cY^2) \\ &= Z_{theor.} - Z_{loss.} \\ &= Z_{theor.} - (Z_a + Z_n + Z_c) \end{aligned}$$

The significance of the coefficients a and c of the expression (6) can thus be seen at once. They evidently

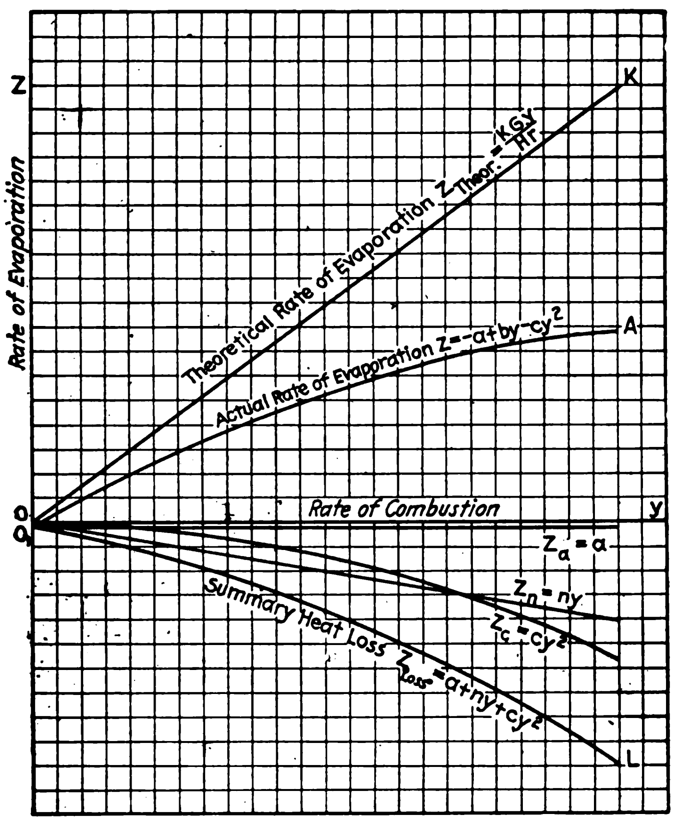


Fig. 2

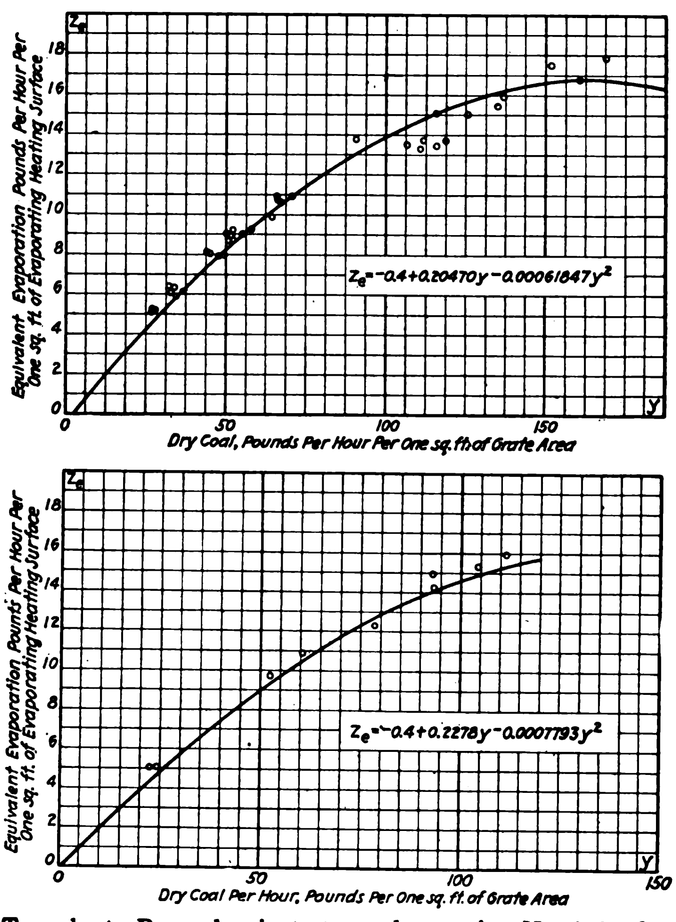
represent heat losses in the boiler, expressed in terms of rate of evaporation. The coefficient a represents the summary heat loss, which is constant and independent from the rate of combustion, while the coefficient c represents the summary heat loss, proportional to the square of the rate of combustion.

The constant n evidently represents a summary heat loss directly proportional to the rate of combustion, and therefore, the coefficient b represents the difference between the theoretical value of the rate of evaporation Z_{theor} and the equivalent heat loss, directly proportional to the rate of combustion.

The above can be conveniently represented graphically as shown in Fig. 2. By plotting values of Z_a, Z_n and Z_c we obtain three curves, each of which represents a summary heat loss, expressed in terms of the rate of evaporation, namely the summary heat loss Z_a, independent of the rate of combustion then Z_n directly proportional to the rate of combustion and finally Z_c proportional to its square. Adding the ordinates of these three curves for each value of y, we obtain the curve O_1—L, which represents graphically the total heat loss and how it varies with the rate of combustion. Subtracting the ordinates of the curve O_1—L from the corresponding ordinates of the straight line O—K which represents the maximum theoretically possible value of the rate of evaporation, we obtain the final curve O_1—A which represents the actual rate of evaporation as it is expressed by formula (6).

Fig 2 illustrates graphically that formula (6) is based on the assumption that the heat losses in a locomotive boiler can be divided into losses, independent of the rate of combustion and losses proportional to the first and second power. Unfortunately, no experimental study of the various losses in the locomotive boiler is known to the writer which would be complete and accurate enough to check numerically this assumption. However, it is quite reasonable to suppose that this assumption is very near to what actually takes place in the boiler. For instance, such heat losses, like leakage, radiation loss, etc., are obviously independent from the rate of combustion.

Again, there are no direct experimental data, which would show, which losses are directly proportional to the rate of combustion; but it is quite reasonable to assume that the loss through the grate, as well as the loss through ash and clinkers is directly proportional to the rate of combustion. On the other hand, we have direct



Top chart—Pennsylvania tests on locomotive No. 790, class Ils. Bottom—Dr. Goss' tests on Jacobs-Shuppert and radial stay boilers

experimental proof, that certain losses, like loss due to sparks and cinders are nearly proportional to the square of the rate of combustion, as it is shown by tests run at the University of Illinois[10] and at the Altoona, Pa., test plant of the Pennsylvania Railroad.[11]

[10] University of Illinois Engineering Experimental Station Bulletin No. 82.
[11] Pennsylvania Railroad Company—Test Department Bulletin No. 21, p. 43.

In summarizing our discussion of formula (6), suggested to express the relationship between the rate of evaporation and the rate of combustion, the following can be stated:

a—The suggested formula satisfactorily fits the experimental data.

b—It accounts for all of the characteristic properties of the relationship.

c—While being strictly empirical, its terms have a definite physical significance, which agrees with general considerations as well as with tests.

The above considerations seem to be of sufficient weight to consider the above formula, if not an exact one, as at least being a sufficiently accurate expression for the relationship between the rate of evaporation and the rate of combustion and to use it as a basic formula for deriving a more or less general expression for the capacity of the locomotive boiler and various secondary relationships.

(This discussion will be continued in the September issue, in which a practical application of formula (6) will be given.—Editor.)

"Bill Brown" started something

A hard-boiled foreman gets after him—Two other interesting and pertinent comments

Our June Shop Equipment Number received an usually cordial and warm welcome. Comments have been received from many sources as to the practical value of several of the more important articles; an unusual number of expressions, however, concerned two of the articles which were more or less closely related. A chief executive of a southern road observes, for instance, "As you can imagine, my particular attention centers in the articles 'The Foreman and His Responsibility' and 'Training Foremen in Leadership.'"

The first of these received the prize for the best article in the *Railway Mechanical Engineer* competition on the responsibilities and opportunities of the foreman (the second prize article will be found elsewhere in this number); the second article was a round-up or study of the methods used in the mechanical departments for coaching or training the foremen and supervisors in the art of leadership and the better understanding of human relations.

Space will not permit publishing all of the worth-while comments which were received. We have selected three, however—one from an old-fashioned, hard-boiled type of foreman and two others from men who are seriously trying to think through the questions of efficient leadership and human relations in the mechanical department. These comments are published in the hope that they will stimulate further thought and discussion on the observations which were made by "Bill Brown," as well as those made by others who participated in the competition on the responsibilities and opportunities of the foreman and whose articles will appear in this and future issues of the *Railway Mechanical Engineer.*

"Bill Brown" drastically criticized

To the Editor:

Referring to the suggestion on page 322 of the June *Railway Mechanical Engineer* and the question: Do you agree with "Bill Brown" in his article on the foreman and his responsibilities.

Well, I'll start the ball rolling by saying emphatically, "NO"!!!

In the first place, I think he should have told his foreman when he joined the band that quite probably he would want to get off for a day in the near future, explaining why. Then he would have been running no chance of creating confusion in the band by finding at the last minute that he could not get away. Why should a railroad shopman play in a town band anyway? His first consideration should be looking after his job and I think his foreman was very considerate in giving him the warning he did.

Then again, if Bill Brown had been as observant as he should have been, and as possibly he has now become, he should have noticed his increase in pay, even though it was small, and should have acknowledged his appreciation with thanks to his foreman for obtaining it—which is only what common courtesy would demand. If he was working for the writer he would get no more increases through him.

The new foreman—What an easy mark Bill Brown appears to be in calling together and speaking to his men as he did. If he worked for the railroad as the writer does, he would have no opportunity to call his men together for any such purpose the second time. He would very probably, and, in my opinion, quite justly, be "canned" by our superintendent motive power as being unfit supervising material.

One may think I am hard-boiled. But is there not too much of this brotherly love stuff being preached? What does it get a foreman but presumptious imposition in most cases? Were the writer in the position of the new foreman mentioned, I would more probably say to the first guy that I found not in absolute accordance with my plans and views: "There are your instructions. Carry them out and quickly too, or the gate for yours. I'm put in here to run this department and by G——, I'm going to run it. Those who put me here think I can do it and I'm going to show them I can. And any guy here who thinks he can stall on me might just as well get packed up."

I'm sure a little rough stuff at the start will have a far greater desired effect than the Sunday School meeting Bill writes of.

He says he is assuming the foremen wish to keep their men. Why does he assume that? Who wants to keep men who are not pulling with him? Show the gate to about two of them and see how quickly the others will get into line. This is not to be done as suggested by Bill as a *last* resort, but as a very *first* one.

Keep acquainted with men's point of view—What time has he for that even if it were a desirable thing to do?

What should a real *he man* foreman care about the men's points of view? That is work for the sociologists who have nothing else to do but wonder what the other fellow is thinking about. Cartoonist Briggs frequently illustrates this.

Reading the railway journals—That may be all right for college graduates and others who are attempting to pick up the railroad mechanical trade. But what can a man who has succeeded in advancing himself to the position of foreman in a railroad shop by his own unaided efforts learn from them that he does not already know from actual experience? The writer has bundles of them not yet out of their wrappers, having no time to read them. And as for the advertising pages being an education, whoever yet saw the machine that would do all the advertising claimed for it?

Treatment of new employees—What is the employment office for? If it sends in one who can't "cut the buck," I say, "chase him" and then tell the employment manager what you want and holler until you get it. About 20 minutes is all I want to size up a man and decide if he will do.

New tools and machinery—You never get the ones you ask for anyway, so why bother? Let the purchasing department look after it. Many of the new machines are no better than some of the old ones. I believe in making the old tools last as long as possible. Just keep them in repair. Much can be accomplished in this way without always whining about new tools.

Sales engineers—There most certainly are shops where salesmen cannot enter and mine is one of them. These guys, if you listen to them, would tell you to scrap some of your best tools. They are always trying to get your goat by some wild story of how much quicker work is being done on some other road than in your own shop, but it is generally a long distance away and hard to prove. They are out to sell goods, not to look after the railway's interests. So why waste your time with them?

Conservation of material—I think the reclamation department one of the most important things in connection with a railroad shop and it should be supported by all departments. Why spend time as suggested by Bill Brown by having his men attempt to use material that should rightfully be first passed through that department. If you drop a 1-in. nut into the pit, use another and let the other go on through the process of getting into and out of the regular salvaging department. It would probably cost more to get into the pit after it than a new one would.

Relationship to the foremen of other departments—More Sunday School stuff. While I would not be delighted, as Bill says, to see the other fellow get into a hole, yet I would most certainly be delighted to have my department ahead of all the other fellows' all the time, if possible. Competition is what peps up all departments. Let the unfit get into the hole and the foreman who is habitually behind take his medicine and make room for another. Getting together and protecting the misfits will not get the organization, as a whole, anywhere. If he can only bat 100, why try to protect him? A foreman can keep quite busy looking after his own department without troubling about the others. I believe in leaving such matters for the shop superintendent or master mechanic to take care of.

Attitude toward apprentices—Well, the "Rev." Bill Brown (which is not his real name or I would not say this) in my opinion is no man for a modern railroad shop and I doubt very much if he will last long wherever he is. No wonder he did not wish his real location revealed. He is altogether too visionary. No doubt he is also an advocate of "The League of Nations." If there is any one class of shop employees that should be treated rough, I'll say it is the apprentices. Let them know from the start who is boss and what they are up against and do not permit the slightest deviation. The rougher you treat them, the better they'll like you when they are through. The picture of "Rev. Bill" surrounded by 20 of his bright boys with a 24-in. vernier in a railroad shop of today is almost overcoming. Who ever heard of a vernier in a railroad shop?

He possibly can get away with his methods for a while. But I am afraid he will eventually be out selling hymn books instead of trying to run a department in a present-day locomotive repair shop, where the routing schedule of his department, supply of materials, heavy cuts and coarse feeds are the subjects that should be uppermost in his mind.

I do not suppose you will care to publish this, but it is at least an acceptance of your suggestion and the way the writer views your first prize article; I am wondering just what some of the others were like, since it got first place. Possibly it was the only entry.

"Top Sergeant."

A follow-up on "Bill Brown"

To the Editor:

Bill Brown said a mouthful!

This, therefore, is not a criticism of his article but rather to augment it. Brown of necessity had to cover a large territory in a few words and naturally could not stress any particular points.

As an ex-supervisor, the responsibilities of the foreman, his location in the organization and his duties always impressed me greatly.

It has been truthfully said that the foreman is the key man in industry. On his resourcefulness depends: Production, costs, co-operation of employees, and interpretation of the policy of the company.

The foreman who can get the maximum production at the minimum cost has the co-operation of the employees and it is obvious is correctly interpreting the business policy.

No amount of assistance from those higher up can or should relieve the foreman of responsibility for the four cardinal points above mentioned. He must synchronize his men, his machinery and his materials; he must have a clear understanding of the problems confronting his men and a definite knowledge of the sound principles and methods of industry. Upon his training, or lack of it, depends the success of his department and as his department is an important unit in the entire organization, the success of the railroad is likewise enhanced or jeopardized.

Keeping posted

That part of Bill Brown's article pertaining to keeping posted is well taken. The greatest problem the foreman is up against is to keep up-to-date. The various railroad magazines and correspondence schools are excellent medium of information and every foreman should be encouraged to study.

It would indeed be Utopia if foremen were given a day off now and then to visit another shop, but what road makes a practice of this? The general foreman, master

mechanic and shop superintendent have this opportunity in their membership in various railroad associations, but the ambitious shop or gang foreman does not, as a rule, have this chance. He must study to gain additional knowledge and unless he is more or less of a student he does not progress very far. Unfortunately the average foreman does not avail himself of the opportunity of study and as a result "carries on" in a manner almost identical to his predecessor which does not make for progress in the railway industry.

Another opportunity of gaining information which is seldom granted the shop foreman is to talk to the salesmen or as "Bill" calls them, the sales engineers. The master mechanic will invariably prohibit the salesman from entering the shop and talking to the foreman and perhaps the sales people are responsible. If, upon being granted permission to talk to the foreman, they would confine themselves to business, there is no question but what the interview would be of mutual advantage to all concerned.

The writer heartily suggests that one of the best mediums of gaining information is for the foreman to join some railway club. An excellent paper is read at each meeting and in addition to this he will have the opportunity of meeting foremen who are employed on other roads.

At a recent regular monthly meeting of the Western Railway Club there were over 400 railroaders and railway supply men present.

So much for keeping posted!

Sizing up men

A foreman, to be highly successful, must be a judge of human nature. Brown suggests that upon promotion the new foreman should call his men together and assure them of his co-operation and request their hearty co-operation. Splendid, but for various reasons, as stated by Brown, such as jealousy over the success of others, there will be one or two men of the gang who will say "bunk" and unless immediately curbed, will and can do considerable damage to the production program. These "kickers," frequently the best men in the gang, can be lined up, if the foreman is a good judge of human nature.

One type can be handled by approbation. Slap him on the back, tell him what a good fellow he is and instead of orders, suggest, and before long this fellow will believe the boss is a "regular guy."

A second type delivers best by constant hammering. The new boss must get this fellow to one side and very frankly say: "Jim, you are not working with me. Without your co-operation the department will fall behind and if it falls behind, one of us is going to get fired and my being the boss, it goes without saying who that one will be." I'll bet Bill Brown has bumped into that type and has handled him in a manner somewhat similar to the one just referred to.

A good foreman knows that each individual has his distinct characteristics, his peculiar likes and dislikes and he has the good sense and common courtesy to treat each man as an individual. He knows that each person has emotions, instinct and temperament and that the best results can be obtained by applying individual treatment to each man under his jurisdiction.

Do not employ a man by sizing up the clothes he wears or his manner of speech. Size him up as a potential supervisor and if in your opinion he can qualify, put him to work.

Do not be afraid of your man getting your job. By his strength and ability to perform, your own job is strengthened and your opportunities of advancement are enhanced.

If there is a more pitiful sight than the man who is always afraid some one is going to get his job, I'd like to know it.

Interpreting company policies

Bill missed a point which I shall designate "interpretation of policy of the company." The difference in operation of a railroad shop and that of a manufacturing plant, insofar as policy is concerned, has always struck me forcibly. In the manufacturing game we know the whys and wherefores. An order is usually supplemented by an explanation of the reasons. The railroad game is of a military form so far as orders are concerned, the big idea being "do it and ask no questions." This operates adversely in two ways. The foreman, without a proper understanding as to the reasons for a certain move, usually becomes militant and balky on the one hand, and, on the other, he loses initiative and feels that a suggestion on his part is decidedly out of place.

The point I am trying to make is that the foreman becomes a mere automaton and performs without consciousness.

Along this line of thought, it is my belief that the foreman should at all times be aware of the reasons for a drastic change in policy. Is it because business is poor that he must cut off his men and use scrap and second-hand material, or is it because a surplus is desired that a general plan of economy may be established?

What a mistake costs

And another thought! The foreman is not taught to think in money terms, as he should be. He should know that instead of Jim Jones spoiling a driving brass by improper machining and treating this as an article, Jim has cost the company so much in labor and material. This thought should permeate all through the railroad. Instead of saying to a car inspector: "Sam, you let XYZ-6000 get by with a defective carrier iron and she dropped a drawbar at Grand Junction causing a derailment," you should say: "Sam, do you know that through your failure to detect a defective carrier iron on XYZ-6000 you have cost the company $375?" Money means something to everyone and if he can get your point of view—that by carelessness he caused a damage equal to two month's pay—you surely have gained a point!

If a machine-hand realized that the machine he was operating cost several thousands of dollars, don't you believe he would treat it better!

If a pipe man realized that by scrapping a valve the company stood a loss of eight or ten dollars and that he could repair this valve in one-half hour, he certainly would stop and think?

All of which leads to the point that the master mechanic should equip his supervisors with price lists on all materials and equipment in order that they may have a better idea as to where money may be saved.

An industrial authority has stated that sixty per cent of strikes are due to bad foremanship. This does not apply to the railroads, but there is no doubt but what the foreman could engender a closer relationship between employer and employee if he were fully aware of the "Why and wherefore."

There was a time when the title of foreman was sufficient to command obedience and respect. The foreman of today must prove himself worthy and capable of leadership, in thought as well as in deed.

An Ex-Railroad Supervisor.

Supports "Bill Brown" arguments

TO THE EDITOR:

Bill Brown in his prize article on "The Foreman and his Responsibility" commences by quoting two of his experiences as a mechanic. Not as a rebuttal, but in a spirit of fairness, I want to tell you something of my experiences as a foreman.

Bill Smith, erecting foreman, wanted a steam chest cover planed for clearance, explaining that he wanted to get the engine off his hands because it was blocking the schedule. Also he was short-handed through absentees and I could plane it quicker than he could set up the pressure plate. I agreed with him since we had more to lose by delaying, and so he sent it over to the planer. Shortly afterward Bill Smith came back and the following conversation took place:

"Have you no authority over your men?" he said. "Jack Jones says he will not plane that cover."

"Well! There must be some mistake. I will go over and see about it."

"Say, Jack," I said, "put this cover up and plane it. It is the only job holding the engine."

"Nothing doing on that job!"

"What is the matter? This cover has to be planed and this is the best machine for doing it."

"All right. But it won't be planed by me. If I have to be fired, it will be for not doing it, as Mr. S——, the master mechanic, told me he would fire me if I planed any more."

This was the first intimation the writer had of a hard-and-fast rule against this practice.

Another time I had occasion to criticize one of the men for neglecting part of his work. The man did not take kindly to this criticism and went to the master mechanic with his grievance, to which the writer did not object in the least.

The following conversation afterwards took place between the master mechanic and writer:

"Did you fire Jack Jones?" said the master mechanic.

"No, sir. I did not."

"All right then. I thought that if you had I would try to place him in another department."

This, too, without an investigation.

What I am trying to tell Bill Brown by these experiences is that to make a foreman realize his responsibility, he must first be given that authority that makes him responsible.

Keeping posted on railroad affairs—I don't believe a foreman in these days of industrial progress can hold his job very long without reading one or more of our mechanical journals, but I don't altogether agree with Bill Brown when he says it is up to a foreman to explain why short hours are necessary, and also about the operating ratios, taxation, rates, etc. Too often, out of a clear sky, a notice is posted in the shop or roundhouse calling for a reduction of hours without any explanation at all. In these days of shop committees, the necessity for this should be explained to them, or the posted notice be made explanatory. Some of our larger railroads are now publishing weekly or monthly magazines. It would make good reading if this information was published in such magazines or bulletins.

Treatment of new employees—Bill Brown has opened up lots of room for thought in his comments on this subject. Too many of us look on a man as a means of production alone, forgetting altogether the human side. I well remember a certain foreman going after a machine man for not turning out as many pieces as he did the day before. That man's wife had that day been taken to the hospital for a serious operation (later she died), and although he knew he should not have been at work, he could not afford financially to lay off. That one instance alone taught me that it did not hurt me one bit to be sociable and that I would not lose any so-called prestige by inquiring about a man's family; in other words, showing that I was interested in other things besides production.

A new man should be made acquainted with his job, and if his job is running a machine, he should be given all the information at the disposal of the foreman about maintenance, production, etc. Pictures, set-ups and time studies can usually be had for the asking from the machine makers or salesmen. Too often we find this literature locked up in the foreman's desk. The writer believes in specialization. Train a man to be efficient in the work allotted to him. Explain what delays mean through underproduction or slack work. Make him feel that that part of the locomotive or car on which he is working is his responsibility and if the part fails, we all fail. In other words, sell him his job.

New machinery—A foreman should be, at any time prepared to show what saving he can make by the installation of new machinery or tools. Sometimes we have difficulty with a job that is only repeated occasionally; on looking through a mechanical journal, we may find that a manufacturer has a machine or device on the market for this work. Naturally, we want it and are apt to lose sight of the fact that the interest on the money spent for this device would more than pay for the time lost by the method now in use.

Foreman's relationship to other departments—Bill Brown's comments on this subject surely hit the spot. The opportunities for the display of inter-department teamwork are truly unlimited. The writer has attended foremen's meetings and noticed the satisfied look on some faces, knowing that their particular department is up to schedule and seemingly not interested in the least in the other fellow being behind. The success of the whole shop or division depends on the weakest link. Your own department may be 100 per cent, but if the rest are only 50 per cent, that will be your shop's rating.

A closer relationship between foremen socially would be beneficial, no matter if it be through organization or arrangement. Representatives of the management can assist greatly in this by attending the meetings, thereby showing that their interest is not confined solely to output. They could also arrange for talks from equipment salesmen, safety men, etc. Roundhouse and backshop foremen should both attend the same meetings. A little friendly discussion of their habitual differences does more good than a lot of letters from the master mechanic and also leaves a better taste in the mouth. If we cannot co-operate among ourselves, how can we expect it from our men?

Times and conditions are changing the relationship between foremen and men so fast that it is difficult for a foreman, trained along the old lines, to change his methods and to realize that maximum service does not depend on him alone, but on the co-operation of every man under him. Let the officers boost the foreman's clubs and organizations by attending themselves or supplying a speaker once in a while to speak at some of the meetings.

A year or so ago one of our large universities sent out a man to deliver a series of lectures to foremen in the city I happened to be in. These lectures opened up an entirely new line of procedure in the handling of men and I

am sure that all foremen that attended derived great benefit from them.

Attitude toward apprentices—I am going to make a broad statement and say that in a modern railroad shop, of say 200 or more men, an apprentice has no place unless a competent instructor is employed. It is not fair to the apprentice or to the foreman to expect him to take an untrained boy and make a mechanic out of him. In the shop where the writer served his apprenticeship, each boy was examined every month as to his ability in the department he was working in and was kept there until fully competent, there being no set length of time in any department. As an inducement to learn and to get through each department quickly, he was given a show in the tool room or on special work and, when possible, given the place of a gang boss. I would like to ask Bill Brown if he happened to have a rush of work and had an apprentice fully competent to handle his share of it, would he transfer him and train another or keep him until the rush was over?

Responsibilities to officers and men—A foreman should never lose sight of the fact that his are the eyes through which the officers see his men and through the same eyes the men see the officers. A foreman, to a certain extent, stands to his men in the same light as a father to his sons. He cannot afford to lose their respect. A slip on his part often results in the loss of morale of his whole department.

In all cases, apply the Golden Rule and your whole department will benefit. "OUTPUT."

The foreman and his responsibility

Second prize article* in the competition held by the Railway Mechanical Engineer

By John H. Linn

Assistant supervisor of apprentices, Atchison, Topeka & Santa Fe

THE foreman occupies a strategic position in a railway organization. He has a vital part in the cost of production and of operation and in building up a loyal, efficient organization. He is responsible not only for the proper care and maximum output of the mechanical equipment of his shop, but also for the placement and maximum effort of each man in his charge and for the proper correlation of the work of the various gangs so as to produce the highest efficiency of the department as a whole. Upon his shoulders rests the responsibility not only for the immediate output of his department but also for the building up of an organization which will determine the output in years to come.

The foreman is the connecting link between the management and the men. He is the representative with whom the rank-and-file come in closest contact. He embodies to them the corporation. He is the company's man. If he is fair and considerate and his example such as to command their respect, it will be easy to create in the men a feeling of loyalty toward the company and of willing co-operation with the management as a whole. But if he is grouchy or ill-tempered or self-centered, or guilty of showing undeserved favoritism, the ill feeling engendered will in all probability extend to the corporation which he represents. The foreman, being in direct contact with the men, is the interpreter of company policies. As such he has a great opportunity for instilling loyalty in the men and for building up the desired morale among the working forces, without which efficient results cannot be secured.

Essentials of successful management

The five essential factors in modern industrial management, whether in railway management or in other industries, are money, materials, machinery, methods, and men. The foreman enters into every one of these factors and is vitally responsible for the solution of the problems involved in each.

Although not directly called upon to provide the capital with which to finance the plant, the foreman in any industry is largely responsible for the amount of money needed, and the ease with which it is secured. If he is wasteful and extravagant, more money will be needed. If the output of his shop is insufficient, it will be difficult to raise the necessary funds to keep the shop going or to enlarge its operations.

The financial responsibilities of the foreman are even more apparent in a railway shop than in an industrial plant. The public is demanding not only more efficient transportation but also that the cost of transportation be lowered. Freight rates cannot be lowered unless costs are reduced. There can be no reduction in cost of materials or needed facilities; neither is it desired to reduce wages. There remains but one solution, and that is to increase the efficiency of the railroad organization and thereby lessen the cost of operation and of maintenance. This cannot be done without the co-operation of the railway foremen. Upon their capacity for organizing their forces, their ability to obtain maximum output from the men in their charge, depends the solution of this problem.

Materials and machinery

Closely related to this heavy responsibility resting upon the shoulders of the railway foreman, is his responsibility for the materials and machinery used in his shop or department. The successful foreman must know the quality of the material he uses, the purpose for which it is to be used, and its fitness for that particular purpose. He must be familiar with the cost of materials and equipment—the original cost, the cost of storing and handling, the cost of deterioration due to exposure, the cost of breakage and of spoiled work, the cost of using more material than the job requires, of using expensive material when an inferior grade would answer, and of the false economy of using inferior material when a better grade is demanded,

*The First Prize Article was published in the June issue, page 360. Criticisms and comments on it will be found elsewhere in this number.

the cost of surplus material becoming obsolete, the cost of his lack of foresight in not having material on hand when needed, the cost of handling materials and the added cost of inefficient methods of handling. The foreman has a great responsibility in keeping all such costs to the minimum. He must know, too, the cost of power, the cost of installation, operation, and maintenance. He should understand the operating cost—when it is advisable to speed up and when to slow down on the time of operation. The foreman is in a large measure responsible for the cost of operation. This cost is largely affected by his ability to handle questions of repairs and replacements, by machines being overloaded or underloaded, of being run too fast or too slow, by machines being idle, by the work of one machine being held up awaiting the output of another machine or department.

As to planning the work

Too much cannot be said about the foreman's responsibility for so planning his work and so co-operating with other departments as to produce maximum output for the department as a whole. The successful foreman must keep in touch with improvements constantly being made in equipment and must make full use of modern up-to-date machines and mechanical devices. He must be aware of the cost of obsolete equipment and of poor layout of equipment, of machines not being conveniently arranged, or of insufficient working space or of certain kinds of work being too widely scattered. His mistakes, whether of commission or omission, are indeed most costly to the railroad.

He is largely responsible for the methods used in his shop. He must know what methods to use, when to use them and how to adapt these methods to the needs of his shop and to the men. It is not the purpose of this article to discuss any particular method; suffice it to say that the foreman has a great responsibility and a great opportunity in deciding on what methods should be used in his department.

Foreman's greatest responsibility

We have mentioned briefly the foreman's financial responsibility, his responsibility in connection with materials, machinery, and methods, but it is in his relationship to his men that his greatest responsibility lies. The amount paid for labor is the biggest bill the railroads have to pay. No part of a foreman's duties are more important than that relating to the human element. No official of a railway organization has more to do with the man-power of the organization than does the foreman, from whom the men take their orders, receive their instructions, and learn of the aims and purposes of the management. No field of railroading offers greater opportunity for effective results than that relating to the man problem. Herein lies the foreman's greatest and most far reaching responsibility and opportunity. As Herbert Hoover says in speaking of our railways "We have devoted ourselves for many years to the intensive improvement of machinery and processes of production. We have neglected the broader, human development and satisfactions of life of employees that lead to greater ability, creative interest and co-operation in production. It is in the stimulation of these values that we can lift industry to its highest state of productivity, that we can place the human factor upon the plane of perfection reached by our mechanical processes." It is upon the shoulders of the foreman that the greatest part of this responsibility must be placed.

There must be greater care in the selection, placement, and training of workmen. In railroading, as in other lines of industry, more systematic methods must be employed to improve skill and to prevent men of talent from being side-tracked in blind alleys, to prevent incompetent, untrained men from being placed in responsible positions; in brief, to prevent the deplorable, and to a large extent, preventable waste, due to human inefficiency. Except where a well-organized training department has been provided, this responsibility rests almost wholly with the foreman. He it is who selects the men; he it is who places them in the shop and assigns their work. From him they receive their instructions and training and promotion. Even where a well-organized training department exists, much of the success accomplished is due to the co-operation and assistance from the foremen of that department.

The foreman must not only "know his stuff" but must know how to impart his knowledge to others. He is, after all, a teacher, a general. He must be a student of nature, must know how to lead and guide others, how to administer discipline, and how to inspire enthusiasm and whole-hearted co-operation. It is well that the foreman have skill in the work of the men he is to supervise. Others may "pass the buck" and depend on some one else for information needed, but the foreman must know whereof he speaks. He must be able to show by example how the job should be done. Having been through the mill and regular grind himself he can better sympathize with his men and understand their problems. Being a first-class workman, able to deliver the goods himself, he can better command respect and obedience from the men in his charge, can more intelligently issue orders and offer suggestions as to methods of performing work, and can intelligently pass judgment as to quality and quantity of work performed. Truly the foreman possesses unlimited responsibility. But more important than the responsibility placed upon the foreman in the requirement that he have knowledge of the work he supervises is the responsibility resting upon him in knowing how to keep the work moving from the rough to the finished job, and the responsibility resting upon him in properly managing the men who are under him.

The wrong kind of foreman

Nothing is worse for a company, nor the men employed by it, than unrestrained power in the hands of a passionate, narrow-minded man. A foreman with a quick temper and a sharp tongue who thinks more of showing his authority than of getting the work out, who makes no effort to keep his men satisfied or to inspire them to the best that is in them, can sow more discord in a minute than the most diplomatic manager can eradicate in a year. An incompetent foreman keeps the shop in a turmoil and the workmen irritated. Not knowing how to keep the work going systematically, he complains and scatters blame around when he alone is the culprit.

No matter what a foreman's other qualifications may be, his influence will be bad if he is not honest, courteous, considerate, and of good habits. In disciplining, a foreman must never forget that his men are human beings with just as much self-respect, as much pride, as much manhood, and as much "touchiness" as he himself possesses. To be placed in a position to pass judgment or administer discipline gives one no right to do it harshly. Workmen know when there is kindness behind the discipline meted out to them. A reprimand may make or sour a man. A merited calling down, administered in the right spirit will be far more effective than an ill-tempered "bawling out."

After all, as was said by the late President Smith of the New York Central: "It is not the powerful modern steam locomotives, or the still more powerful electric motors, or the endless chains of freight and passenger cars, or the well-appointed terminals, or the solidly laid tracks, or the intricate signal system; it is not all this elab-

orate net-work of equipment that makes the railroad wheels go around 24 hours of every day of the year, it is the human heart beat. Unless the great majority of those constituting the organization are working in harmony and working heartily, the results can only be disappointing."

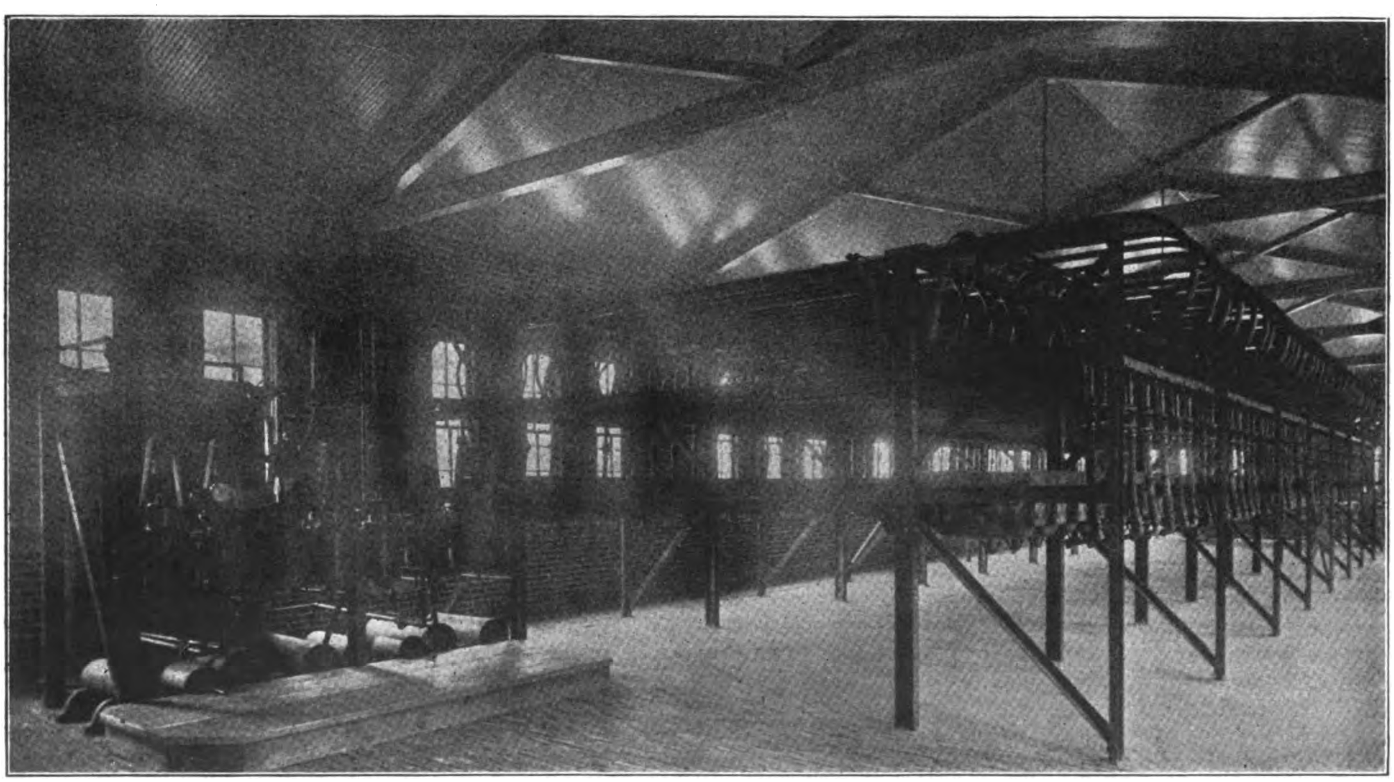
It is the duty of the foreman to bring about this harmony of effort on the part of his men. Without this co-operation, maximum results cannot be achieved. Again we repeat, the responsibility resting with the foreman is exceedingly great.

Have an understudy

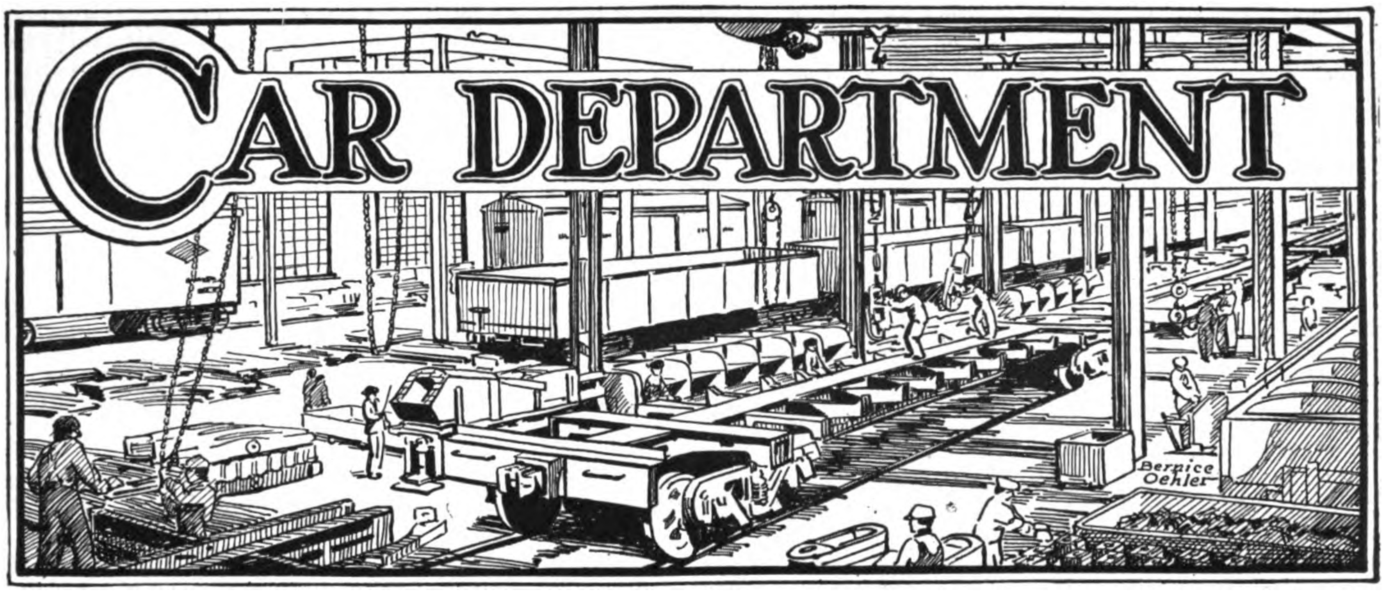
One other responsibility resting with the foreman should be mentioned and that is his responsibility for having someone under him trained and ready to take his place. He should take a competent, carefully selected man under his wing and personally train him to follow in his footsteps, giving him the benefit of his experience and giving him a chance as opportunity offers to try out and develop his ability, not only in the absence of the regular foreman, but at other times when the successful foreman is at hand to note and correct his mistakes, giving him an opportunity to profit by the lessons others have learned but leaving him sufficient freedom to use his own originality and initiative. A foreman who is so narrow minded and selfish that he is unwilling to give an understudy full opportunity for development, fearful that he himself may be surpassed in promotions, is himself unworthy of promotion and the sooner he is relegated to the discard, the better for all concerned. If each foreman will see to it that he has someone ready to take his place, the problem of securing competent supervision, which causes trouble in many shops, will be solved.

We repeat, the foreman occupies a strategic place in a railway organization. Upon his success or failure the whole organization depends. They are the men who get results. From them, the future executives of the railway will be chosen. Upon their shoulders rest the output and loyalty of the rank-and-file. To their sympathy and understanding of their men and their everyday problems, their understanding of and ability to carry out the aims and policies of the management, their ability to produce immediate output and to build for the future, the efficiency of our transportation system must be attributed. Truly a railway foreman has a great responsibility and a great opportunity.

Illinois Central rules for storing coal.—The Illinois Central has issued rules governing the unloading and caring for storage coal. The ground upon which coal is to be stored must be firm, level, clean and properly drained, although no drainage should pass through or under the storage coal piles. Coal, which is unloaded into storage should not be placed on loose cinders, against wooden posts, wooden trestle bents or hot or warm pipes or flues; nor should it be placed in piles to exceed 12 ft. in height and 36 ft. in width at ground level, with the piles limited to 1,500 tons, and spaced with intervening distances of at least 5 ft. The piles must not be ventilated by artificial methods. Coal of different sizes should be placed in separate units and this same practice of segregation holds true when unloading coal of same size from different mines. Coal should not be dropped from the grab buckets more than 3 ft. The coal should not be moved after once being placed in storage, unless absolutely necessary. The temperature of the coal should be taken at least once each week, and oftener if possible, using either the thermometer or rod method; and when coal is stored under cover, the structure should be well ventilated to afford outlet for gases. Under no circumstances should water be applied to a heated coal pile. Heated or burning coal should be removed and used, or extinguished by scattering and then applying water.



The air brake rack at Purdue University comprises equipment for two locomotives and 148 freight cars—A chronograph for recording the time of application of the brakes is also included in this equipment.



How to stop hot box epidemics*

Regular reports will show where the trouble originates and a personal investigation of causes should follow

By A. M. Orr
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IN discussing the problem, "How to stop hot box epidemics," it will be assumed that proper material has been supplied to the oiling and repair forces, and that they have been so trained that the hot box record has been satisfactory in the past. This being assumed, it is unnecessary to discuss any of the details of the proper handling of packing and oiling.

The problem seems to divide itself into the following minor problems:

1—How are we to know that a hot box epidemic is upon us?
2—What is the probable cause?
3—What repair point or division is responsible?
4—What action is necessary?

It is probable that on every road there is a system of reporting a car which has been set out of a train before reaching its destination. That report is made, as a rule, by wire to the chief dispatcher. If the report does not already contain that information, it will be easy to change it to show the point where the car was picked up, and the fact that it has been set off for a hot box. A copy of each of these defective car reports should be furnished to the master car builder daily. In his office the reports should be classified as to the point of origin of the car. When reports come to the master car builder's desk, he will be able to tell at a glance whether any repair point is chargeable with more than its usual number of hot boxes. Thus, immediate knowledge is furnished to the head of the department concerned of any increase in hot boxes.

It is not worth while to try to itemize the probable causes of hot box epidemics, for they will be precisely the same causes which are daily causing individual cases. There are, however, certain general suggestions which can be made. If there is a sudden jump in the number of hot boxes on the morning report, and if those hot boxes all come from one station or district, it is probable that the trouble is a local one. More especially will this inference be true if the increase in hot boxes has been gradual, and chargeable to one station or district. If, on the contrary, the increase is relatively sudden and all, or nearly all stations are involved, then the cause is not local. Keeping this subdivision in mind, it is sometimes possible to determine very quickly what the trouble is.

Should the trouble be general, and in the fall or spring of the year, one may stop the trouble in 36 hours by arranging for a supply of oil which suits the weather conditions, a cause not always given as much attention as it should have. Or perhaps a visit to the stores department waste storage may disclose a supply of waste which has not the necessary capillarity.

If, on the contrary, the attack is very sudden and very sharply defined as to origin, one may by inquiry find that a lot of foreign cars have come on the road for loading, or that some home cars which have been stored for a long time have been moved forward for loading without having been given preliminary attention to insure that the journal packing is in good condition.

As a general rule if the increase is relatively slow and local, look for disorganization of repair force or local trouble with material; if the increase is sudden and wide spread, look for a special trouble, first of all in quality and handling of oil, waste and bearings.

If the report already suggested has been kept up daily, there is an immediate answer to the question "What repair point is responsible?" if the increase is sudden and local, but hot box epidemics which come from poor material may be several weeks developing. This will be true, for example if the quality of journal bearings fur-

*A paper submitted in the competition on hot box prevention.

nished has changed for the worse. It may be several months before the full effect of such a change will be manifest.

It is desirable, therefore, to have a historical report which will cover considerable periods of time. One such report may be made weekly in the simplest possible form. It is not to locate responsibility, it is only to point out tendencies. If for example, a report is made which shows weekly the number of hot boxes on east and west bound traffic, or on traffic from certain special loading districts, that report will call attention in a general way to general will show general tendencies. If such a report is made, it is important that the master car builder or his travelling car inspector shall, by personal instruction, make sure that all repair points are using the same method for determining what a hot box is, for if there is not such a general practice, some stations may be reporting as hot boxes some which others would not. It is not usually practicable to determine the point of origin of hot boxes on cars which are carried through to a terminal, nor is it really necessary, for experience shows that the relative mileage based on cars set out, and the mileage based on total hot boxes will

East and West Railroad
Statement of cars set out of trains
en route for hot boxes
Year 1923

Station at which car originated		Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
A		22	12	31	26	53	112	131	124	66	60	37	29	703
B		..	..	..	..	..	..	..	..	..	..	1	..	1
C		2	..	1	1	1	..	..	..	..	1	..	1	7
D		3	3	1	4	4	2	1	2	1	1	2	1	25
E		4	..	..	..	..	1	..	..	..	..	..	1	6
F		9	5	13	9	11	3	9	4	4	6	4	8	85
G		11	12	14	19	18	5	12	10	7	8	7	4	127
H		69	67	106	98	126	124	112	109	84	47	62	33	1037
Total cars	1923	120	99	166	157	213	247	285	249	162	123	113	77	1991
Total cars	1922	24	26	47	39	16	130	217	169	315	191	123	103	1402
Miles per car set out	1923	36574	38770	29883	32584	34158	36566	36524	38882	54400	70524	50446	49392	40669
Miles per car set out	1922	87351	80470	59799	86102	157592	54608	37327	47804	22256	37016	44806	39681	43073

Summary statement showing total hot boxes by months and comparative mileage figures

increases which might be overlooked on the daily reports because of the gradual increase.

The real historical report should be monthly, and it should go into details. It is desirable, first of all to know how many hot boxes caused real trouble; that is, caused cars to be set off en route. It is these hot boxes that block the tracks to traffic while the cars are being set off and being picked up, that are responsible for the breaking of couplers while heavy trains are trying to shove a car into a siding and that cause large expense for repairmen not vary more than perhaps 10 per cent, unless the transportation department has taken a special interest in the hot box question and has managed to get the conductors interested in taking cars through to terminals rather than to set them off. Such special attention, while the new standard of mileage is being established by the conductors will throw the relative values off for a while.

One road, by working steadily with the train masters, was able to get conductors interested in applying grease to hot journals, looking after them in a general way while

East and West Railroad
Statement of hot boxes in freight cars
Year 1923

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Set out of train en route ...	130	109	176	167	223	257	275	259	172	133	123	87	2111
Other hot boxes	216	166	390	367	515	658	522	519	370	316	215	162	4416
Total hot boxes 1923	346	275	566	534	738	915	797	778	542	449	338	249	6527
Total hot boxes 1922	140	125	179	215	167	686	462	567	855	579	402	316	4693
Transportation service miles per hot box													
Total 1923	13358	14499	9173	7773	10243	10264	12433	12458	16331	19500	17007	16263	12612
Total 1922	16871	20592	17198	16820	16623	10683	17853	14534	8641	16137	14139	13611	13302
Loaded car miles per hot box													
Total 1923	10030	9503	6763	7773	8383	8243	9487	9650	12293	14643	13186	10372	9725
Total 1922	10242	12408	11798	10301	10252	6324	9009	8861	7288	10862	14047	9413	9167

Example of report of hot boxes originating at different stations

who have to go out on the road to repair them at non-repair points.

It is also desirable that these hot boxes be accumulated monthly as to responsible stations, so that the tendencies at those individual stations may be observed in a general way. A repair point may gradually crawl up from 10 or 12 hot boxes per month to many times that number without attracting special attention on the daily reports. The monthly report shows that increase clearly.

If the report includes also a statement covering not only the hot boxes set out en route but also those found at terminals, there will be an additional measuring stick which waiting at meeting points until the mileage per car set off increased from 8,702 miles to 39,073 miles four years later.

It is because of the possibility of such fluctuations that it is best to use the total hot box record as an indicator. The actual figure used will, of course, be some function of service. The loaded car mileage is desirable in some ways, for it is most productive of hot boxes, but it is well generally to use the total transportation freight car mileage.

That figure will vary on different roads. A road of light equipment may show a high mileage per hot box while a road of high speed heavy traffic may show a low

mileage per hot box. The figures of one division will vary from another. As with most other railroad statistics, they should be always used with caution as relative figures, showing tendencies.

What action can be taken to stop the hot box epidemic? It will be noted that the measures suggested are mostly indirect and preventive. It is necessary to see that the materials supplied are of such quality that under favorable conditions there will be a good bearing upon a journal which is perfectly smooth, against which presses a packing of proper texture to feed an oil of sufficient quality to maintain a film of .003 in. between the journal and the bearing.

But as in every other situation, and more so than in some, the real controlling factor is the human one. Starting with the daily report, let it be the routine practice for the master car builder or his travelling car inspector to make a personal visit to or talk with, by 'phone, every foreman whose station has increased its usual hot box debit for the previous 24 hours. This seems quite a job, but if it becomes evident to the men on the job that a personal explanation will be called for every time the hot boxes increase, there will come the feeling, "Guess it will be well to see that cars are right when they go out." The written letter or memo will never take the place of the personal visit. It is important that the men higher up keep in mind that it is not a question of a "bawling out." The greater part of the time the cause of the hot box was not the fault of any single individual. The attitude should be taken that what is wanted is information. After this practice has been carried on long enough, there will be a steady flow of information on the subject. A distant foreman will report that brasses shipped to him arrived with linings loosened from the back or scored and full of grit and sand. That involves the crew of the local freight perhaps: but it is not a case of trouble for them. Very likely they look upon brasses as pieces of metal to be handled with as little care as brake shoes. A word of friendly explanation may remove that trouble instantaneously and forever.

Next may come one of the men from the receiving department of the store room. He has learned from similar suggestions that waste is not something to wipe machinery with when the car department is concerned, but a medium of transmitting oil to a journal. He has a sample of new waste which makes him suspicious. What does the M. C. B. think of it? Psychology teaches us that we can many times increase the productivity of human labor by affording a point of interest to the worker. Properly handled, this system will provide that point of interest.

When the preventive work has failed, and when the hot boxes increase, then it is necessary to consider the problem, and it can only be handled on the ground. The man who is bucking that problem is the same as the wreckmaster. He must go to the source of the trouble, which he knows from his daily report. What he will find there may be anything that will make a hot box. He must work right with the oilers, he must ride the trains himself and work with the hot boxes which develop to see just what the trouble is. If the trouble lies with a supply of below-grade bearings which have been gradually applied over a considerable time he may have a long job, or it may be that 24 hours work will end the trouble.

The valuable thing about such a system is that it practically stops anything which can be called a hot box epidemic. After the lapse of sufficient time, nearly every man on the road will be interested in keeping down that hot box record, especially if the monthly tendency report is carried on a blue print or mimeograph sheet so that cumulative figures for the year are shown. A copy should be sent monthly without comment, to each repair point.

Mileage figures as already suggested are very delusive when used as means of comparison, so that actual mileage figures will not be stated. But it seems reasonable to affirm that any road which does not have such a close personal check on the hot box problem, regardless of how good its figures look, may expect an improvement of at least 50 per cent in the number of miles per hot box within two years after commencing such a system, besides the immediate location of the place responsible for an attack of "hotboxitis."

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Responsibility for damaged car involved in a derailment

An inspection certificate was issued on April 7, 1922, by the Maine Central for Bangor & Aroostook car No. 6228, which was accompanied with a letter dated April 12, 1922, which explained that the cost of repairs exceeded the prescribed allowance under A. R. A. Rule 120. The Maine Central requested the car owner's authority for the certificate and advice as to what disposition was to be made of the car. Authority was given to repair the car and a bill amounting to $349.61 was rendered for the repairs. It later developed that the car was damaged on the Maine Central in switching at which time C. P. car No. 344,353 was derailed. The Bangor & Aroostook stated that the Maine Central requested authority to issue an inspection certificate but did not mention that the car had been damaged in connection with the derailment of C. P. car No. 344,353, nor did it show how the damage to the car occurred as required by A. R. A. Rule 43. The car owner concluded its case by stating that it was wrongly reported under A. R. A. Rule 120 and should have been reported under Rule 112. This contention was based on Interpretation No. 4 of Rule 32, which states that a car damaged in connection with a derailment carries the same responsibility for damage as a car derailed. These facts place the responsibility for the damaged car on the handling line. The Maine Central maintained that the care failed in switching due to its weakened condition.

The Arbitration Committee rendered the following decision: "In view of the derailment of C. P. car No. 344,353, the Maine Central is also responsible for the damage to the Bangor & Aroostook car No. 6228 which occurred in the same accident."—*Case No. 1326, Bangor & Aroostook vs. Maine Central.*

Failure to apply a defect card at interchange

On September 8, 1923, A. C. L. car No. 39620 and on September 11, 1923, S. A. L. car No. 30715 arrived at Laurens, S. C., in a train of the Columbia, Newberry & Laurens, each car with a centrifugal dirt collector missinspection record. The cars were delivered to the ing, which were noted by the car inspector on the original Charleston & Western Carolina with the dirt collectors missing and no defect cars attached as required by A. R. A. Rule 2, paragraph I. The car inspector at Laurens is

a joint inspector for the C. & W. C. and C. N. & L. The C. N. & L. refused to furnish the inspector with any of its defect cards but required him to request all defect cards from its headquarters at Columbia, S. C., a distance of 75 miles, giving the initial and number of the car and the defects in each case. The defect cards are then issued and sent to the inspector. This accounted for the cars being delivered to the C. & W. C. without the defect cards attached as required by the rules. The inspector wrote the C. N. & L. for defect cards to cover these two cars, which were refused on the ground that the cars had gone over the C. & W. C. to Spartanburg, S. C., before the request for defect cards was made. The Charleston & Western Carolina contended that A.R.A. Rule 2 does not provide for any time limit in which to request defect cards and that if the Columbia, Newberry & Laurens had supplied its inspector with a supply of defect cards, so that he could have attached a card to each car before offering it in interchange, as required by Rule 2, the C. N. & L. could not have raised a question. The C. N. & L. claimed that the joint inspector at Laurens failed to note any equipment missing from these cars on arrival at Laurens and as the cars were moved to Spartanburg, S. C. without Rule 4 being complied with, the C. & W. C. should assume the responsibility for the existing defects on the cars.

The Arbitration Committee in rendering its decision stated that, this controversy is due to the evident disregard of Interchange Rules 2 and 4, first paragraphs, which provide for the defect carding of cars at the time and place of interchange. If the cars had delivering line defects, they should have been properly defect carded at the time of interchange.—*Case No.* 1324, *Columbia, Newberry & Laurens vs. Charleston & Western Carolina.*

Passenger car scheduling system

Increases shop output and reduces working force to a minimum—Competent supervision essential for its successful operation

By Joseph Gullage
General foreman, car department, Boston & Maine, Billerica, Mass.

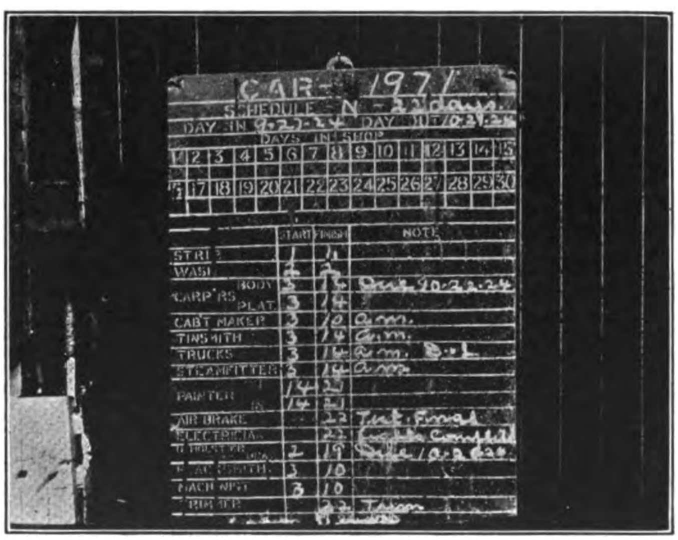
SCHEDULING and routing in railway shops is not new. The first schedules recorded were used in the Chicago & North Western shops in 1904. These consisted simply of working sheets and assigned dates made out and followed up by the shop supervision. Since that time more than 25 railroads have adopted some form of schedule system for repairing cars; all of which are more or less alike in basic principles.

In 1922 at the convention of the Mechanical Division of the American Railway Association at Atlantic City, the Shop Schedule Committee proposed a plan for scheduling cars through the shops. During the latter part of 1922, the Billerica shops of the Boston & Maine put into effect a passenger car scheduling system based on the one proposed by the Mechanical Division committee but modified somewhat to meet the particular conditions at this point. This shop gives general repairs to all types of wooden passenger equipment and the ordinary run of repairs to steel cars. The track capacity of the shop is 60 cars—30 cars in the coach shop and 24 cars in the paint shop—six cars being under wash or paint removal in the latter shop. The output of the heavy and medium repairs is four cars every working day, while the number of light repairs vary. During January of this year, for instance, eight light repair cars were turned out while in February there were 78. However, the monthly average is from 15 to 20 cars.

Points to consider when installing a scheduling system

When installing a scheduling system, there are several items of importance to consider before putting it into effect. If these items are not given considerable thought there is always the liability of the system failing to function properly owing to the lack of proper organization and control.

The first item to consider is the selection of the proper man as the schedule supervisor and to determine the scope of his duties. The man selected for this position should have had wide experience in shop and office work, should be capable of handling men and should have enough engineering practice to make clear reports and records. Preferably this man should have served his apprenticeship as a



Shop bulletin sheet which is displayed on or near one end of each car under repair

car repairman and be more or less familiar with shop production methods. Before putting the scheduling system in force, it is always advisable to send the schedule supervisor to visit various production shops to study the methods used to increase production.

The supervisor's duties should be definitely determined. At this point he is required to digest the inspectors' reports as to the general condition of the cars to be

repaired, on the strength of which the schedule time is set by him for the completion of all the work, subject, of course, to the general foreman's approval. He also has direct charge of the shop inspectors, the receiving yard for crippled cars and the outgoing tracks for repaired cars. foreman makes the final decision in case his decision does not meet with the approval of those concerned. His office provides the reports on shop output and shop conditions. He acts as a sort of a liaison officer between the different foremen on matters pertaining to shop output.

NUMBER OF DAYS IN SHOP	9	10	10	14	15	16	12	15	22	17	34	37	22
EXTRA PAINT & OTHER WORK									BURN	BURN			
SCHEDULE / OPERATION	A	B	C	D	E	F	G	H	J	K	L	M	N
PAINTERS													
START WASH		2	2	2	2	3	2	2	3	2	2	2	2
FINISH WASH - IN & OUT		2	2	2	2	4	2	2	4	2	2	2	2
TOUCH UP : BEGINNING	6	6	6			10	7						
START BURN								2	3	2		3	3
FINISH BURN								2	4	3		3	3
SAND - AFTER BURN								3	4	4			
PRIME - OUTSIDE				6-7	7-8			7-8	12-13	9-10	27-28	31	14-15
PUTTY, SAND & SURFACE NO.1				8	9			9	14	11	29	32	16
SURFACE NO.2					10			10	15	12			17
SAND & COLOR NO.1	7	7	7	9	11	11	8	11	16	13	30	33	18
ENAMEL	8	8	8	10-11	12-13		9-10	12-13		14-15	31-32	34-35	19-20
COLOR NO.2													
VARNISH NO.1		9		12	14	12	11	14	17-18	16	33	36	21
VARNISH NO.2						13			19		15		
VARNISH NO.3													
ENAMEL NO.2													
LETTER		9	9	11	13	13 PM	11 AM	13 PM	18 PM	15 PM	32	35 AM	21
PAINT UPPER DECK	7	7	7	10	9	11		11	16	13	29	33	16
PAINT LOWER DECKS	7	7	7	10	9	11		11	16	13	29	33	16
START INTERIOR		6	6	7	9	11	8	9	16	11	29	30	16
FINISH INTERIOR		9	9	11	12	14	9	13	20	15	32	34	20
STEPS, PLATFORMS		7	7	10	8		10	13	17	15	30	33	20
BOTTOMS, TRUCKS		7	7	10	8			13	17	15	32	30	21
FINISH DECKS, STEPS, ETC.		9	9	10	12	14		13	18	15	32	36	21
STENCIL	9			13									
TOUCH UP - FINISH						14			20	16			
CARPENTERS													
TRIM STRIP													
DISMANTLE FOR STEEL U'FRAME													
START BODY	1	3	3	3	3	5	3	4	5	5	1	4	4
START PLATFORM WORK		3	3	3	3	5	3	4	5	5	1	4	4
FINISH BODY	5	5	5	5	6	9	6	7	12	8	26	28	14
FINISH PLATFORM WORK		5	5	5	6	9	6	7	11	8	26	28	14
CABINET MAKERS (BENCH FINISH - 1)													
STRIP START		1	1	1	1	1	1	1	1	1		1	1
STRIP FINISH		1	1	1	1	2	1	1	2	1		1	1
WORK START		3	3	3	3	5	3	4	5	5	1	4	4
WORK FINISH		5	5	5	6	9	6	6	11	7	20	24	12
TINSMITHS													
ROOF START		3	2	3	3	5	3	4	5	5		4	4
ROOF FINISH		5	4	4	6	8	6	7	11	7		26	13
TRIM FINISH (IN TIME TO SHIFT)						9			11		25		
STEAMFITTERS													
PIPE FINISH, COVER & TEST		5	5	5	6	8	6	7	10	8	24	24	14 AM
TRUCKS													
DISCONNECTED, - OUT	1	3	3	3	3	5	3	4	5	5			
OVERHAULED - START	1	3	3	3	3	5	3	4	5	5			
OVERHAULED, FINISH, UNDER & CONN.	5 AM	5 AM	5 AM	5 AM	6 AM	9 AM	6 AM	7	11 AM	8 AM	25	28 AM	14 AM
AIR BRAKES													
FINISH, TEST	9	10	10	14	15	16	12	15	22	17	34	36	22
ELECTRICIANS													
ALL WORK FINISHED & TESTED		5			6	9	5	7	22	8		24	
BLACKSMITHS													
ALL WORK - FINISHED	4	4	4	4	5	7	5	6	9	7	20	22	12
UPHOLSTERERS & BRASS WORK													
STOCK RECEIVED		2	2	2	3	4	3	2	4	2		2	2
TRIM STOCK FINISHED									18			24	20
MACHINISTS													
ALL WORK, FINISHED	4	4	4	4	5	8	5	6	9	7	21	22	12
CAR TRIMMERS													
TRIM FINISH	9	10	10	14	15	15-16	12	15	21-22	17	34	37	22

This chart is a summary of the passenger car schedules and is put in this form for the convenience of the schedule supervisor

A yard shifter is assigned to the shops for transfer work, the engine crew of which takes orders from the schedule supervisor. His work also includes decisions as to the standard of workmanship which may be in question between his inspectors and the shop foreman. The general

The location of the office of the schedule supervisor is the next item to be given consideration. This office should be located conveniently with respect to the shops, preferably in the office of the general foreman, which is the case at the Billerica shops. It is important to have this office

so located that the supervision can frequently confer with the schedule supervisor and have ready access to and examine the records on the schedule board.

The master schedule

As each car comes into the yard an inspection of the car and painting is made to determine the class of repairs. The arranging of a schedule depends largely on the longest job on the car, which is usually the paint. It is then good policy to have the painters start their work as soon as possible and arrange to have the other work on the car finished at the same time that the painters start.

The first requirement of the schedule supervisor at Billerica was to plan the master schedule. The schedule, which is shown in the large illustration, is a board upon which is laid down the work to be done on all possible units of equipment used by the B. & M. which come to the Billerica shops for repairs or rehabilitation, from the dining car to the box car carrying a coat of pullman color and the words "Fitted for passenger service," stenciled on its side.

Referring again to the master schedule in the illustration, on the left, will be seen the names of the different paint operations and crafts. The painting operations appear first, which as previously mentioned, determine the length of time the car will be in the shop. For example, it may require as many as 14 paint shop days for a dining car which is made necessary because one coat of paint or varnish must be dry before another can be applied. It is essential to show all the paint operations complete on the master schedule.

The other crafts shown on the board are merely mentioned by name, as a board showing all the various jobs of all the crafts would be one of impossible dimensions and almost out of the question to read.

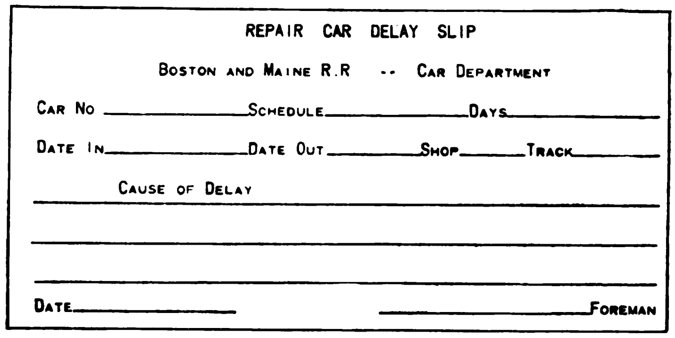
On the top margin of the schedule, at the head of each column, is a row of letters A, B, C, and so on up to N. Immediately above these letters are figures running from 9 to 37. The letters indicates the type of car and the class of repairs and the amount of paint work necessary for each car, while the numbers indicate the total days required to perform this work and the total days the car is in the shop.

How the master schedule is used

To make clear to the reader the application of this schedule to a particular class of work, we will follow a car through the shop according to schedule *M* on the master schedule. This schedule calls for 37 shop days in which time a vestibule passenger coach will receive a steel underframe, the vestibule will be reconstructed and the outside body paint removed and reapplied. On Day 1, the strippers strip the car and distribute the various parts to the proper departments for repair. At this point it is well to mention that the departments are informed as to when they should have the parts for which they are responsible repaired and back to the shop in time to be reapplied in the car. This time is flexible insomuch that each department can finish each part of the work beforehand and store it away until required. Coming back to the master schedule, on Day 2, the car is washed and finished both inside and out. On Day 3, the car is moved to the track where it will stay until turned out. On this day the painters burn the paint off of the car complete. On Day 4, the carpenters start to work on the body and the vestibule of the car. The tinsmith and the truck gang also start their work on this day. It will now be seen that all crafts are working on this car in order to complete it by the end of the 37 shop days. By the twenty-eighth day, all of the crafts have finished their work. Machinists and blacksmiths finish on the twenty-second day. The upholsterers and brass workers, the electricians, steam fitters and cabinet workers finish their work on the twenty-fourth day. The tinsmiths on the twenty-sixth day and the carpenters on the twenty-eighth day. The car is now free for the painters to work on.

Should any hidden defects appear during this time that will necessitate a longer time than allowed by the schedule to complete the work, this situation is generally overcome by increasing the number of men employed on the job, taking them from a car just in the shop or from one on which there is but little to do. This procedure usually prevents the car from going out late.

The car moving through the shop on schedule *M* is now complete in so far as all the crafts are concerned except



REPAIR CAR DELAY SLIP

BOSTON AND MAINE R.R -- CAR DEPARTMENT

CAR NO ______ SCHEDULE ______ DAYS ______

DATE IN ______ DATE OUT ______ SHOP ______ TRACK ______

CAUSE OF DELAY

DATE ______ ______ FOREMAN

Pink delay slip which must be filled out by the foreman who is responsible for retarding the progress of a scheduled car

the painters. The car is now in the paint department where on the thirtieth day the painters start to work on the interior and finish on the thirty-fourth day. The trucks and the bottom of the car are also painted on the thirtieth day. On the thirty-first day the painters start the outside of the car and finish it by the thirty-sixth day. On this day all paint work is finished as well as all the repairs to the air brake equipment. On the thirty-seventh or last day in the shop, the car is in the hands of the trimmers who usually complete their work in time for the shifters to pull the car out of the shop, 99 per cent complete. There is always a final inspection and touch-up time is required, which takes place after the car leaves the shop. When complete, the inspector carefully goes over the car and declares the car ready for service on the date assigned. This is a typical case and the movement of all the other cars through the shop is similar.

The use of the individual schedule board

In order to make this schedule system effective, it is essential to have a number of cars on the waiting list for repairs. With 20 or 30 cars waiting to come in the shop, it is much easier to maintain a steady run of output than is possible if only 6 to 10 or less cars are on hand. These crippled cars can be arranged to pass through the shop in such a manner that neither the paint nor coach shop will be overloaded to the detriment of the other. After the cars have been arranged on the waiting list, according to the class of repairs required for them, the inspector goes over each car in as thorough a manner as is consistent with his other duties, making notes of the condition of the car so that when it arrives in the coach shop the inspector assigned to that shop can, with the data gathered by his colleagues, immediately hang a card on the car which carries a summary of the defects for the benefit of the foreman in whose section the car has been placed for repairs. This card is also of first importance to the schedule supervisor who at a glance can grasp the extent of the necessary work to be done, and with that coupled with his own observation and the chart of the cars in the

coach and paint shop, he can immediately assign a date for the completion of the coach shop repairs as well as of the paint and the trimming.

When the schedule has been determined and the dates have been placed on the planning board, a schedule board is then written up and placed on the car where it remains until the car is complete. The information contained on this board is copied on the form shown in one of the illustrations by the schedule supervisor who sends duplicate copies to each of the foremen who is responsible for any of the work done on the car.

The schedule board is about 18 in. by 24 in. At the top is placed the number of the car and immediately below it, the schedule letter and shop days for completion. Below this appears the number of days in the shop and following this is a list of the various operations to be performed on the car with the start and finish time after each item.

BOSTON AND MAINE RAILROAD

MECHANICAL DEPARTMENT

No Billerica Shop - Car Department

Schedule -- B Days -- 11

Car No 479 Day In 8-21-24 Day Out 9-3-24

Day In Shop

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Craft	Start	Finish	Note
Strip	1	1	
Wash	2	2	
Car Body	3	6	Due 8-27-24
Car Plat.	3	6	
Cab't Maker	3	5	
Tinsmith	3	6	AM
Trucks	3	6	AM Down & Level
Steamfitter	3	6	AM
Blacksmith	3	4	
Machinist	3	4	
Air Brake		11	Test - Final
Gas. Oil, Elec.		11	Lights - Complete
Upholsterer	2	8	Due 8-29-24
Brass Work	2	8	
Paint Out	7	10	
Paint In	7	10	
Trimmer		11	Trim
		12	Ship

This form contains the same information found on the schedule board which hangs on the car under repair—A duplicate is sent to all the foremen interested

The start and finish columns are important, and as each day passes the checker marks off the vital days as they terminate until he comes to the day on which the work of the carpenters should be complete. If the car is delayed a day or more, every day it is late is checked off the schedule and a report is filed in the office of the general foreman for his information. If the information is sufficient and satisfactory, the general foreman accepts the report, but if he feels that it is not acceptable, he asks for a pink slip, or repair card delay slip, from the foreman in charge, which must clearly state the cause or causes of delay. If these causes are such as will warrant the excuse of the foreman then the delay is passed on to the originator of the cause. This delay slip, which is shown in one of the illustrations, is very effective as the foremen bend every effort to avoid a pink slip. As a result of this co-operation on the part of a foreman, a delay chargeable to negligence has never been filed at the North Billerica shops.

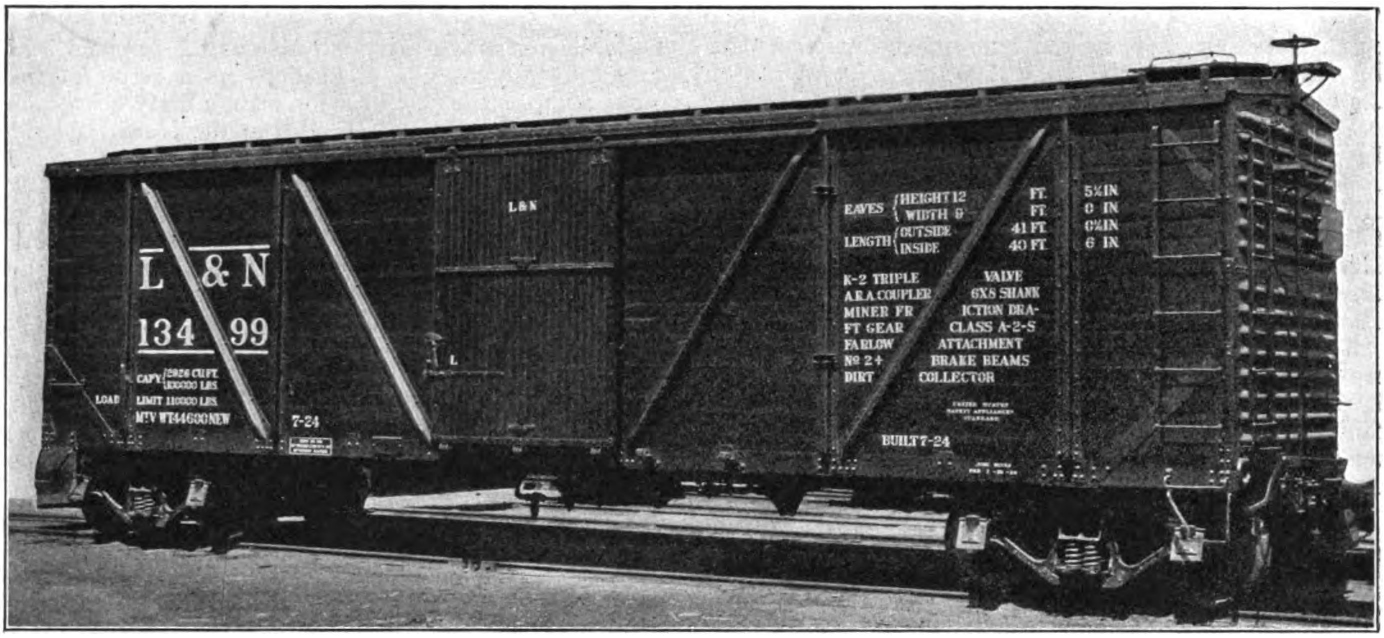
The different crafts working on the car within the carpenter days, do so according to the days which are assigned for their particular work. As each craft completes his work, the foreman O. K.'s the board against his craft's name, so that when the coach shop foreman is ready to send the car over to the paint department, he looks over the schedule board on the car to determine if the tinsmith, truck department, etc., have completed their work as required. With the board completely checked off, the paint shop will have no delay on account of work not being finished in the coach shop. Neither will the painter have any hammering on the body of the car which causes dust to fly through the air and settle on the fresh varnish, which naturally does not add to the appearance of the finished car.

The master schedule is supplemented by a large planning board which carries 31 blocks, to cover days in the longest month. Each block is divided vertically into four columns, one each for the car number, the date in, the schedule designation and the date out. Horizontally, each block is divided into two parts, one for the coach shops and one for the paint shop, and each of these parts contains six horizontal lines to accommodate a record of a maximum of six cars. As each car is given a date out of the coach shop, the car number, its date in, schedule designation and final completion data are entered in red in the coach shop portion of the block representing the schedule day out of the coach shop. The same information, with the exception of the completion date is entered in blue in the paint shop portion of the block representing the final completion date. The purpose of placing the car number in these spaces is so that no more than four or five cars, which carry the same completion date will be scheduled out of either the work or paint shop on the same day, as any more than that number would mean a delay. The daily capacity of the paint shop is around four to five cars. Therefore, in order to avoid confusion, it was found necessary to employ some scheme of separation. The planning board tends to smooth out the output in a steady, even flow of a predetermined number of cars for each day.

Benefits derived from a scheduling system

Schedule boards indicate infallibly where delays periodically or persistently occur and such departments may be built up or strengthened. Under the day work plan, which is used at this shop, the system acts as a stimulant and to some extent, takes the place of interest in the work removed through the abolition of piece-work methods. Friction between departments is almost entirely eliminated. It is not possible to unload on one department causes for delay which belong to another.

This system to some extent establishes tasks or jobs. Every conscientious foreman or workman likes to have certain work to perform in a stated time and to feel confident that this is exactly what is wanted. Each schedule date delivered to the foreman or workman becomes a written order to that man to deliver the work on that date. Unnecessary driving is brought to a minimum. Dates are assigned and if the work is properly done on these dates, no criticism or censure is necessary. The constant reappearance of the daily delay report stimulates foremen and workmen to a better purpose than criticism. Scheduling has enabled us to reduce our man power to the proper ratio to the output.

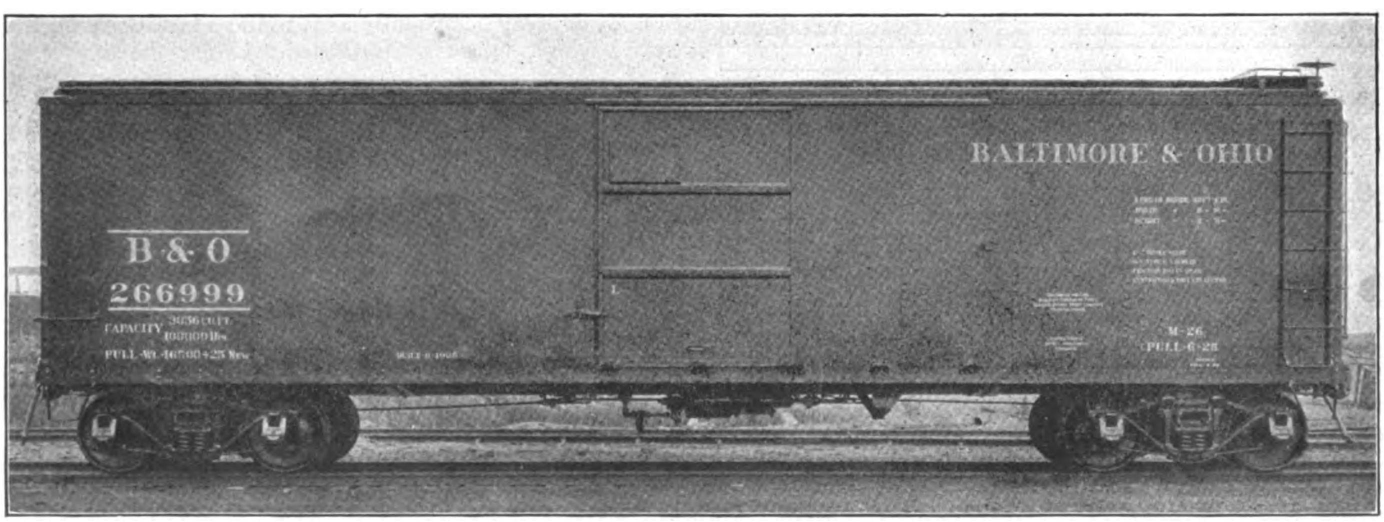


Louisville & Nashville standard 50-ton single-sheathed box car—Builder, Mt. Vernon Car Manufacturing Company

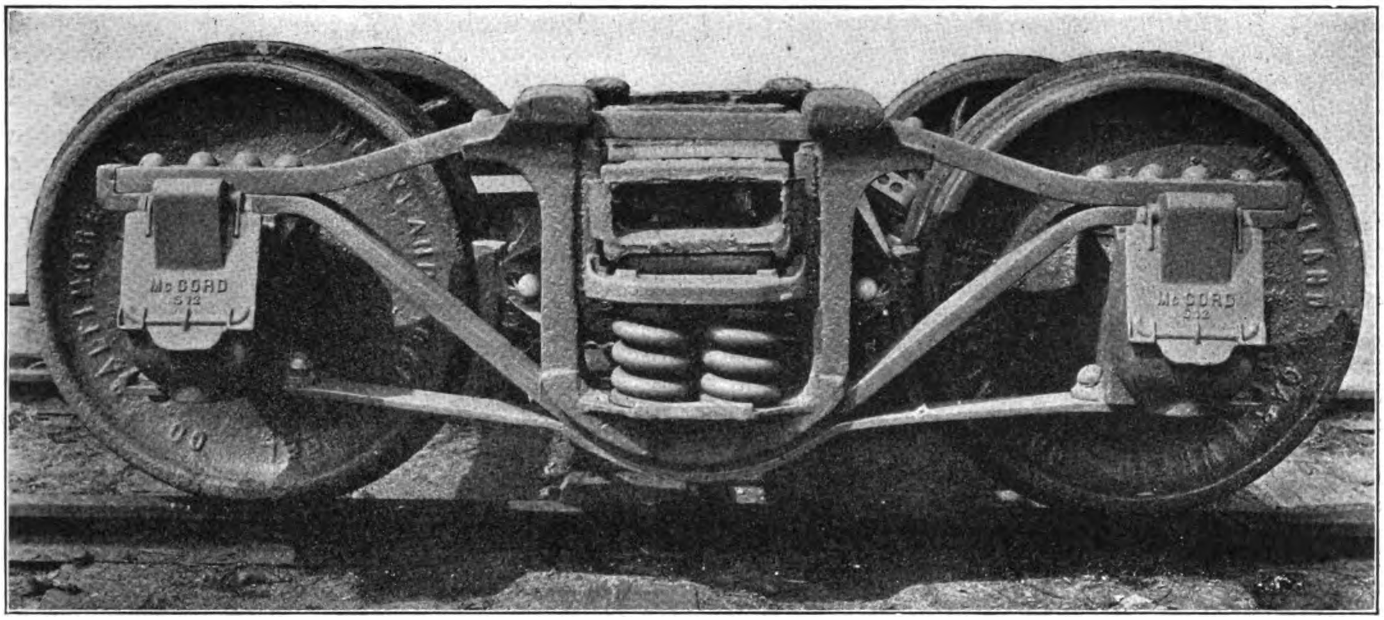
Exhibit of proposed standard box cars at Chicago

Built from designs proposed by Committee on Car Construction—B. & O. shows two all-steel cars with trucks of special design

ONE of the features of the recent meeting of the Mechanical Division of the American Railway Association held at Chicago was the exhibit of the present and proposed standard box cars which was shown on tracks No. 4 and No. 5, slip A, South Water street yard of the Illinois Central. This exhibit constituted a most instructive and valuable supplement to the report of the Committee on Car Construction, an abstract of which was published in the July *Railway Mechanical Engineer*. These cars, which included both the proposed double—and the present standard single-sheathed types, were sent to Chicago by a number of representative railroads. They were interesting, not only because they were built in accordance with the standard designs as worked out by the committee, but also on account of the fact that they embodied many alternatives which can be applied without departure from any essentials of the standard design. In addition, the B. & O.



Baltimore & Ohio 50-ton double-sheathed box car—Builder, Pullman Car & Manufacturing Corporation



The Tatum XLT truck used on one of the Baltimore & Ohio box cars

also exhibited two all steel cars equipped with trucks of special design. The following is a brief description of these cars.

The A. T. & S. F. 40-ton double-sheathed box car

An illustration of the A. T. & S. F. 40-ton double-sheathed box car of the proposed standard design 4C-XM2 was shown on page 426 of the June *Railway Mechanical Engineer*. The equipment thereon includes:

Trucks: A. R. A. side frames on both trucks. The truck at the "A" end of the car has an A. R. A. bolster design with separate center plate and standard friction side bearings The truck at the "B" end of the car has a separate center plate and bolster design modified to accommodate the Barber lateral motion device and Barber roller side bearings. A. R. A. standard springs and spring plank are used on both trucks.

Brake beams: The truck at the "A" end is equipped with a Creco No. 2 beam and standard A. R. A. suspension hanger. The truck at the "B" end has a Creco No. 2 plus brake beam, Santa Fe standard malleable hangers and Santa Fe brake beam safety suspension.

Connections and truck levers: A. R. A. standard is used with both.

Journal box lids: The truck at the "A" end has Asco self-fitting torsion spring lids; the "B" end of the car has Symington B-2-A malleable lids.

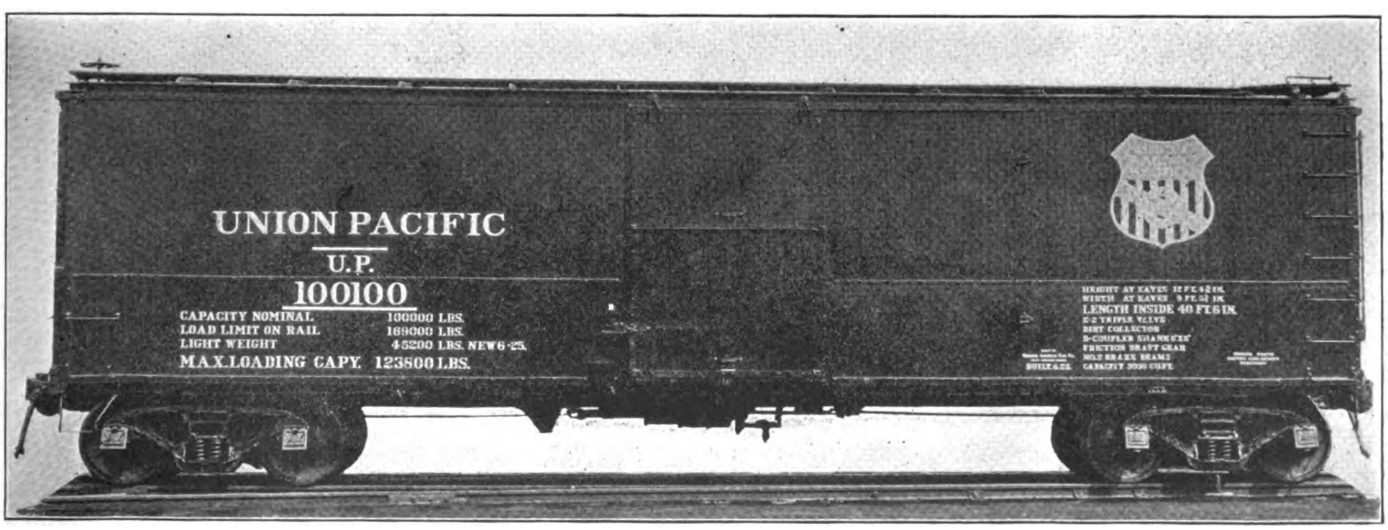
Ends: The "A" end of the car has a built-up standard end with posts; the "B" end has a Murphy corrugated end.

Side doors: Both doors are bottom hung. One door has A. R. A. standard sections of framing. The door posts on one side of the car are pressed as shown on the proposed standard design (see page 433, July *Railway Mechanical Engineer*); the other side of the car has the front door posts pressed, but with the front stop omitted. The front stop is a Camel section, riveted to the post. The rear door post is pressed with the outside flange omitted, and Camel weather strips are riveted to it. The rear frame of the door on this side of the car has a Camel standard pressed angle, while the front framing includes a Z-bar providing the necessary lap in the front stop. The top and bottom framing is made of Z-bar sections, as shown on the standard details.

Roof: Murphy radial all-steel flexible roof.

Yokes: Santa Fe standard cast steel yokes made by the American Steel Foundries.

Draft gear: National friction draft gear, type M/17,



Proposed standard 50-ton box car with wood sheathing and lining—Builder, General American Car Company

at the "A" end of the car, and Miner friction gear, type A-2-X, at the "B" end of the car.

Uncoupling device: Santa Fe standard, Imperial type A at both ends of the car.

Body side bearings: At the "A" end of the car, A. R. A. standard design. Those at the "B" end of the car are modified to accommodate Barber roller side bearings.

Air brake: Westinghouse.

Marking: Santa Fe standard, conforming to A. R. A. specifications.

The Union Pacific 50-ton double-sheathed box car

This car is 46 ft. 6 in. long inside and has a capacity of 3,038 cu. ft. The light weight is 45,200 lb. which leaves a maximum loading capacity of 123,800 lb.

The equipment on this car, which is of the 4D-XM2 class (see page 428, July *Railway Mechanical Engineer*), includes:

Trucks: The "A" end has Huntoon brake beams, Schaefer brake hangers, levers and connections; Wood's roller side bearing, and Allegheny Steel Company's journal box lids. The "B" end has Creco beams and Railway Steel Spring Company's journal box lids.

Ends: The "A" end of the car has a corrugated end; the "B" end of the car is of the standard built-up type.

Uncoupling device: Carmer.

Side doors: One side has an A. R. A. standard top-hung door and fixtures. The other side has a modified Camel top-hung door and fixtures.

Roof: Murphy solid steel riveted type.

Yokes: Buckeye steel yokes at both ends.

Angle cock holders: Western Railway Equipment Company at the "A" end, and A. R. A. at the "B" end.

Draft gear: Murray on one end and Cardwell on the other end.

Air brake: New York.

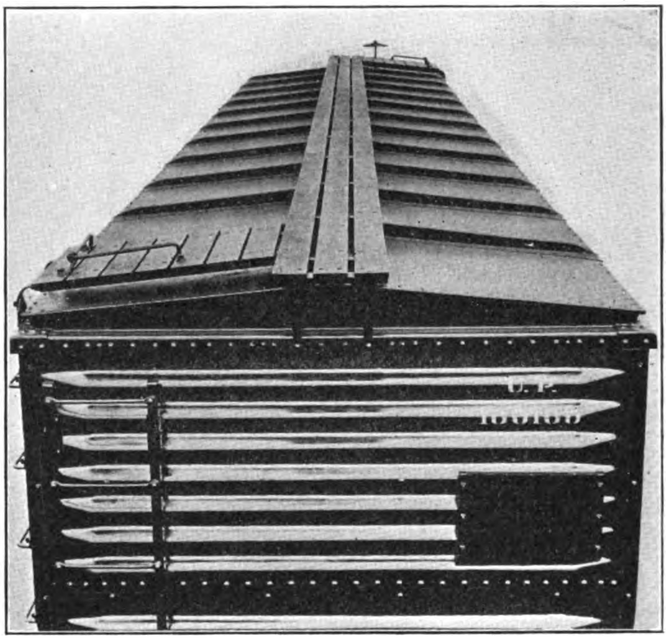
Nuts: Grip and boss nuts.

Marking: Union Pacific standard.

Notes on the 40 to 50-ton double-sheathed cars

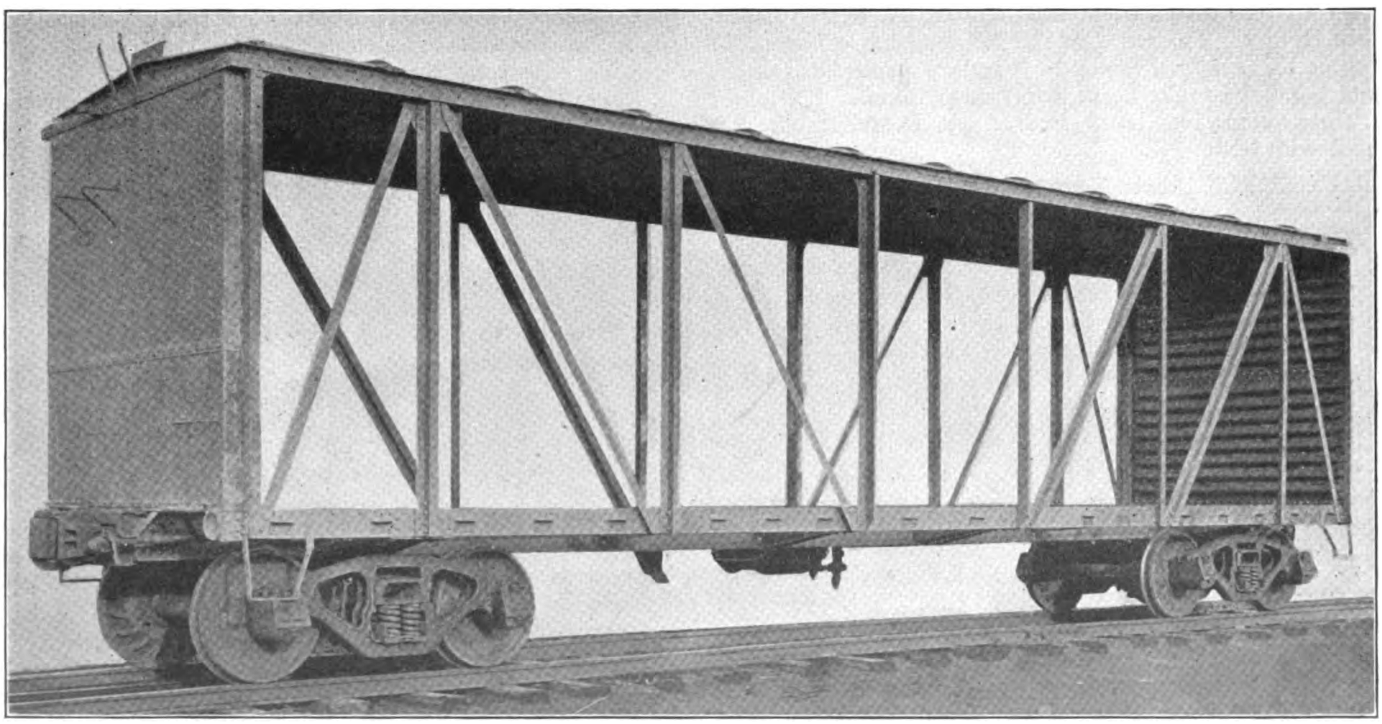
In general construction the 40-ton and the 50-ton double-sheathed box cars are the same, although various parts are naturally of lighter construction for the 40-ton car. Some of the differences are enumerated herewith.

The underframes are of the same standard section as that previously adopted for single-sheathed cars, the differences in the frames being so slight that if adopted for the double-sheathed car the same design could be incorporated in the single-sheathed car. The crossbearers have been moved to coincide with the location of the door



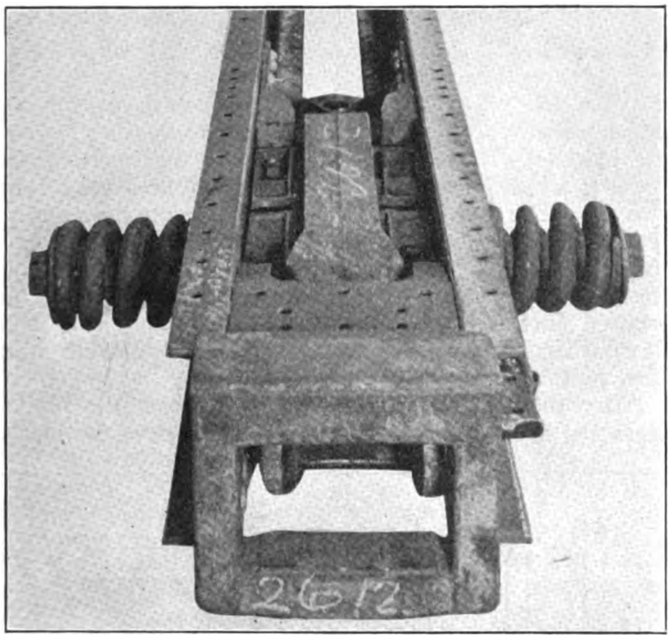
Murphy solid steel roof and the corrugated steel end of the Union Pacific car

posts, a change that could readily be adapted for single-sheathed cars. The body bolster top cover plates are ½-in. thick for 50-ton cars and ⅜-in. thick on 40-ton cars. The same difference occurs in the crossbearer top cover plates. These dimensions can apply also to single-sheathed cars. The side sills are punched the same for



Body framing of the Union Pacific car, mounted on temporary trucks—Built-up steel end at the left

both top and bottom-hung doors. The Z-bar side plates are 1/4-in. thick for 40-ton cars and 5/16-in. thick for 50-ton cars. The transom posts are 3/8-in. thick for 40-ton cars and 1/2-in. thick for 50-ton cars. The punching for posts, braces, sills and plates are identical for cars of either capacity. The end sill angle has been shifted 1 7/16-in. but the same punchings of the underframe have been retained, the punching of the sill being changed to



Combined draft gear lug and end stop casting

suit. The end plates are the same shape but they have been offset in order to accommodate vertical posts or built-up ends. The holes in the end sill angles have been spaced so as to take a standard uncoupling device.

A particularly interesting feature of the design is the combination dead block and front draft lug. This combination is shown in one of the illustrations.

Louisville & Nashville car

The sample car exhibited by the Louisville & Nashville is of the standard single-sheathed design, in the construction of which a number of alternates have been incorporated. It is of 50-ton nominal capacity and weighs 44,600 lb. light. It has corrugated steel ends and XLA outside flexible metal roof. The draft gear is Miner friction, class A-2-S with Farlow attachments; the coupler release attachment is the Carmer. The trucks have cast steel side frames with journal boxes cast integral. The truck bolsters are fitted with roller side bearings.

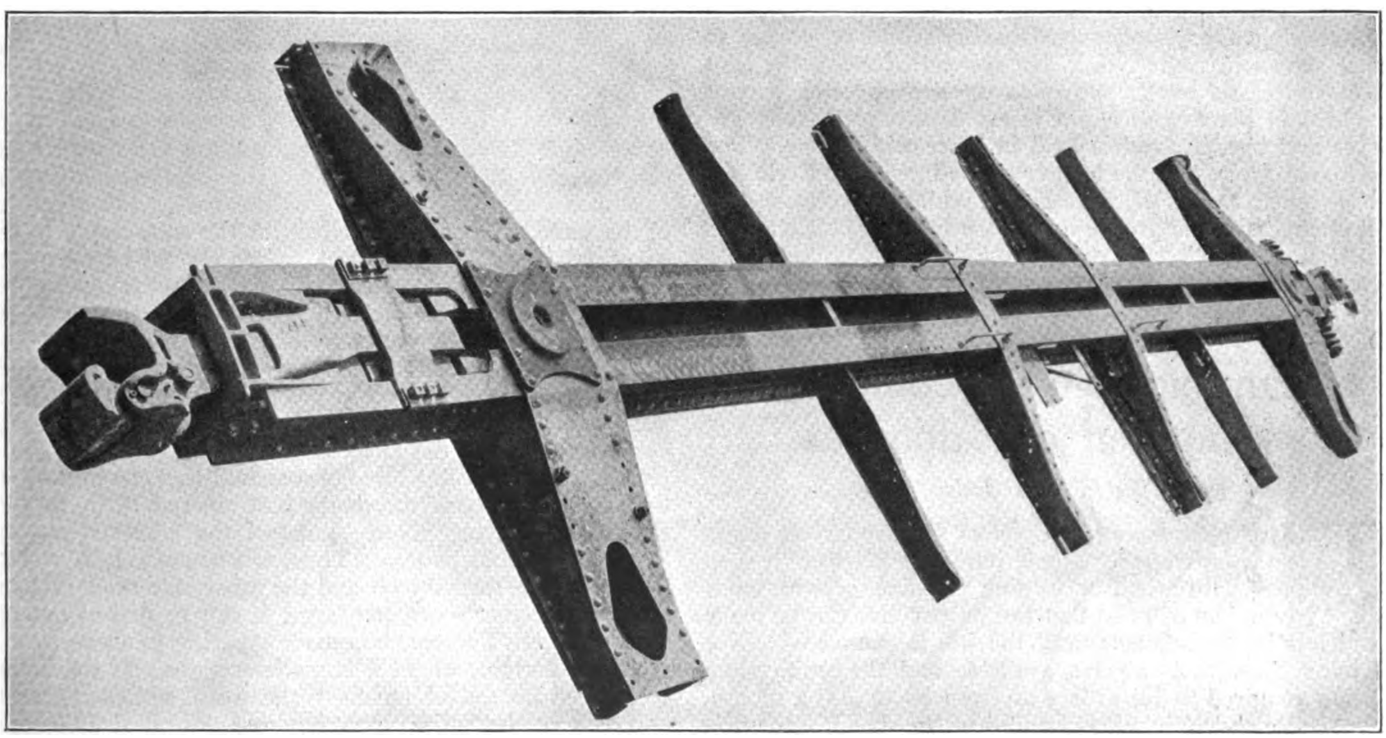
The B. & O. double-sheathed cars

Two 50-ton double-sheathed cars with two new types of trucks were exhibited by the Baltimore & Ohio. These are 40 ft. 6 in. long, 8 ft. 9 1/8-in. wide and 8 ft. 7 3/8 in. high—all inside measurements. The capacity is 3,056 cu. ft. The light weight is 46,900 lb. which leaves a maximum loading capacity of 122,100 lb.

One of these cars was equipped with the Tatum patented arch bar flexible truck which is built without bolts, nuts, washers or keys, except for the brake pins and the lower connecting rod, and the brake pin used in the live lever rod connected to the bottom brake rod. The column post is locked to the top arch bar by wedges and rivets. The bottom arch bar and the tie bar are free from any sharp bends. The side frames are flexibly connected by a 6-in. pivoted channel bar. This truck design includes the Tatum-Zell waste and oil retainer, a brake beam suspension without brake hangers and fulcrum bar safety straps.

The other car was equipped with the Washburn patented arch bar truck side frame, which was described in the *Railway Mechanical Engineer,* May, 1924. There is quite a difference between the weight of the Washburn truck and the standard M. C. B. truck. The M. C. B. arch bar truck with 1 1/4-in. by 6-in. arch bars weighs 8,640 lb. with the lateral motion device. The XLT truck weighs, without the lateral motion device, 8,145 lb.

In discussing the 1925 report of the Committee on Car Construction one of the committee members, J. J. Tatum,

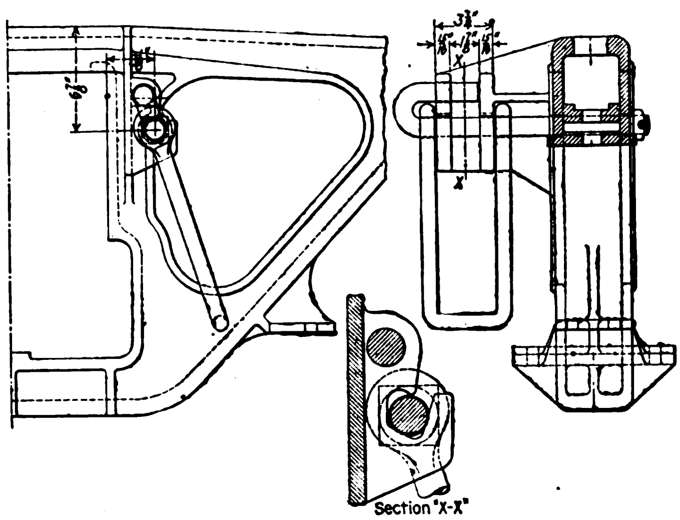


Inverted underframe of the proposed standard double-sheathed box cars

general superintendent car department, Baltimore & Ohio, stated that the committee was not prepared to give the comparative strength of the two trucks under the two different cars, but the M. C. B. arch truck under a static load of 125,000 lb. deflected 1.50 in. and had a permanent set of 1.23 in. The XLT truck under the same load deflected 0.19 in. with a permanent set of 0.10 in.

Proposed brake hanger bracket

The Baltimore & Ohio is also investigating the possibilities of a brake hanger bracket for cast steel truck side frames. Five proposed styles have been developed, of which Style No. 2 is shown in the drawing. The bracket design is the same for all five proposed styles. The method of applying the hanger, however, is different. The hanger shown in the drawing is the proposed A. R. A.



Proposed Style No. 2 of brake hanger bracket for cast steel side frames

standard brake beam hanger, Classes 2C, 2D and 2E. Style No. 1 is made to the same dimensions as the proposed standard hanger, but is forged in a solid loop, the top portion of which is flattened so that the hanger can be inserted into the hook of the bracket. The proposed standard hanger is also used in Style No. 3, similar to that shown in Style No. 2, but instead of using the bent bolt and castle nut as shown in the drawing, the hanger is held in place with a pin inserted through the hanger eyes and bracket, and is held in place with a key. The method of applying the hanger to the bracket in Style No. 4 is similar to that of Style No. 2, with the exception that the hanger is made to be inserted inside the bracket jaws instead of outside as shown in the drawing. Style No. 5 employs the same type of hanger as Style No. 4 but is secured by a pin and key as in Style No. 3.

Manufacturing eyebolts for hopper car doors

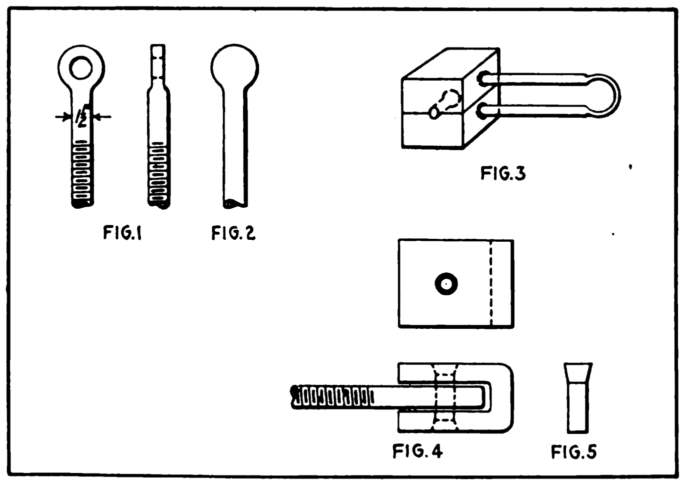
By F. E. Deissler

THE manufacturing of eyebolts for hopper car doors is a comparatively simple job if the blacksmith shop is equipped with a bolt or forging machine, or with sufficient power hammers so that the proper dies can be made and left in the hammer until the job is completed. Not having these tools always available and the smith shop being required to fill orders of from 50 to 200 a month, the device shown in Figs. 3 and 4 of the sketch was made so that the steam hammer could be used for other work when necessary.

The kind of eyebolt made is shown in Fig. 1. The material used is 2½-in. round stock which is cut off at the shears to the required length, heated, balled at one end and flattened. The other end is then drawn out to 1½ in. diameter. Sufficient heat remains to punch the hole while the piece is still hot and the job is completed except for the threading.

The tools used for this work are the spring swedge, shown in Fig. 3 and the die and punch shown in Figs. 4 and 5. These tools are made by forging a master ball as shown in Fig. 2. The two blocks of steel for the spring swedge are then forged to the required size and reheated. The master ball is placed between the two blocks which are driven together under a steam hammer. After the blocks are cooled, holes are drilled the same size as the bar used for the handle as shown in Fig. 3, and shrunk. The job is completed by inserting the ends of the spring handle in the holes and electric welding around the handle to prevent it from coming out or turning. If the electric welder is not available, the handle can be secured just as satisfactorily by drilling a ¼-in. hole down through the block and handle and driving in a steel plug.

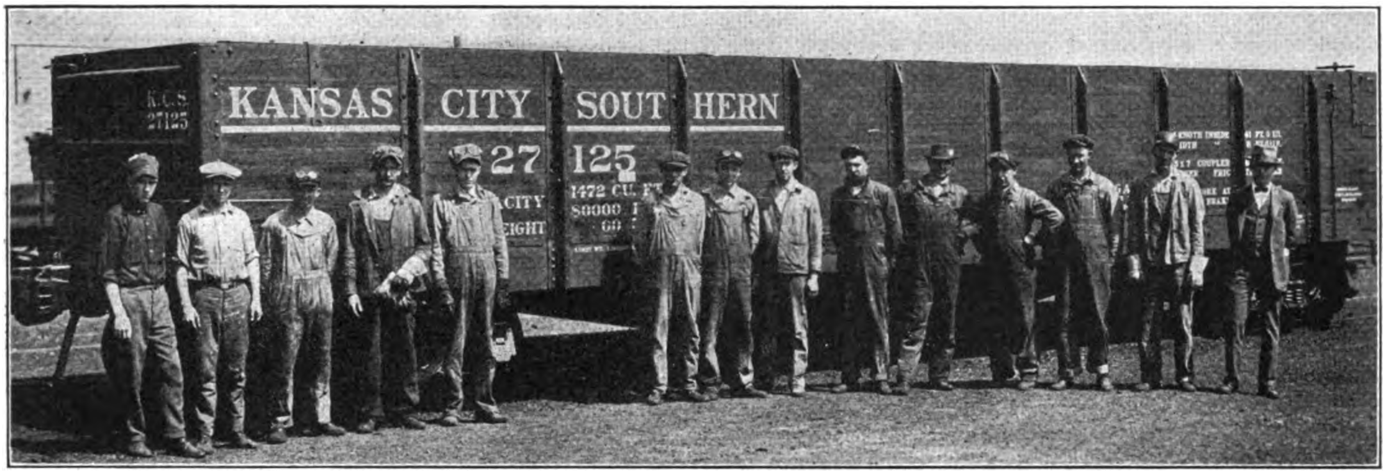
After the handle has been applied, reheat the blocks, place the master ball in the swedge and close the blocks



Quantity production of eyebolts can be obtained with this device on a power hammer—No permanent dies or special equipment are required

down until they come together, using a little water on the master ball to help clean out the scale and make a smoother tool. The swedge for the bolt shank is made in the same manner as described for the ball, only a piece of round iron is used instead. Care should be taken to make the grooves wide enough and at the right depth so that the work can be turned freely and the swedges will not pinch at the edges.

The die and punch are made as shown in Figs. 4 and 5. The die is made from a piece of 1½-in. tire or tool steel bent to the shape shown, allowing about ¼ in. clearance between the sides of the opening and the material to be punched. The holes should be 1/16 in. larger than the diameter of the punch and tapered ⅛ in. larger at the top, leaving about ½ in. of the hole straight at both the top and bottom. Thus, when one side is worn, the die can be turned over and the other side used. When the hole becomes worn too large, it can be drilled out to a larger size. The punch is made tapering to about ½ in. from the bottom, where it is made straight. If the holes are drilled instead of punched, the work will cost nearly as much as the entire operation just described. On the other hand, if the eyebolts are finished cold, the work will require extra handling, which adds to the cost.

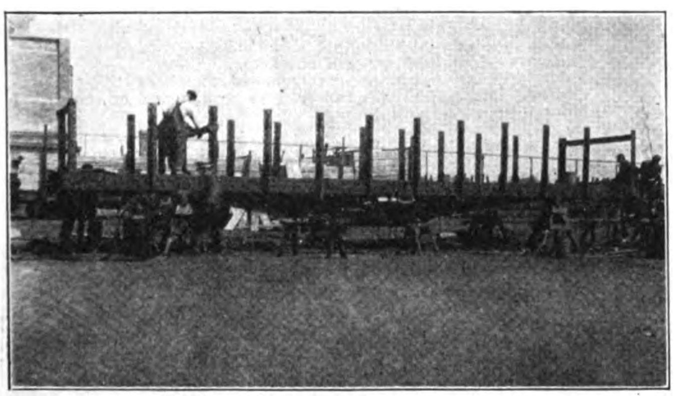


The completed car and apprentices who repaired it—C. Y. Thomas, apprentice supervisor, at extreme right

Apprentices repair gondola unaided

Kansas City Southern car shop apprentices give practical demonstration of their knowledge

WITH no intention of breaking records, but simply to show the results of apprentice training and to increase the incentive and interest of the boys in their work, it was recently decided to have a group of apprentices at the Pittsburgh, Kans., shops of the Kansas City Southern completely rebuild a freight car. As a result, 13 of these boys were selected, and they performed without assistance all the operations involved in giving Class 1 repairs to a composite gondola in four days, or slightly over five days if the time required for painting is counted. A 27,000 series, K. C. S. coal car was chosen for the test, this type of car having a steel underframe and being of 40 tons capacity, 42 ft. 7½ in. long and 8 ft. 10¾ in. wide, equipped with Andrews trucks. These cars were built in 1913 and are now being given heavy repairs for the first time.



Lining up side stakes after riveting—Body bolsters riveted in —Straightening end sill, B end

The car selected, No. 27,125, was set at the Pittsburgh steel car shop May 11, being left outside the shop to facilitate photographing. It was stripped of sides, end boards and nailers, the stripping being done as usual by laborers on the stripping track. Laborers also sand blasted the underframe.

The apprentices working the car were placed under the direct supervision of an apprentice who acted as lead man. No assistance of any kind was given the apprentices by the car repairers, car foremen or lead man. All necessary instructions, few in number, were given by the supervisor of apprentices, C. Y. Thomas, and the superintendent of machinery, M. A. Hall, who kept in close contact with the progress of the work because of his keen personal interest in the apprentices and all that they do.

The apprentices selected and assigned to the work on the car were as follows:

Lead man	George Dixon
Gun men	Ben Throne and Oliver Foltz
Buckers	Glen Watson and Gerald Burris
Pickups	John Baker and Hughie Carey
Heater	Floyd Clanton
Mill work	Wilfred Atkinson and Walter Hanes
Air work	Wilfred Atkinson and Milford Stuckey
Painters	Kenneth Lindsay and Elmer Wolfe

The average length of apprenticeship of these boys was approximately 14 months. While the purpose of the test was to show what the apprentices could actually do and it was not intended to be a time or small cost performance, the repairs on the car were made as rapidly as consistent with good workmanship. The total time required, as well as the time when each operation was completed, is shown in the Log of Repairs. The total cost of the job for labor and material was $880.74.

The trucks were in poor condition and it was found necessary to dismantle and completely rebuild them, using the following new parts:

2 new cast steel truck bolsters	4 new Andrews side frames
2 new pairs of wheels	4 new spring caps
1 new box lid	4 new spring rests
16 new box bolts	4 new journal brasses

After assembling the truck next the shop building, it was inverted to facilitate riveting the spring planks and bottom tie bars, while the other truck was jacked up alternately on its sides to be riveted. As soon as the riveting was completed, the boxes were packed and the center plates greased, making the trucks ready for application.

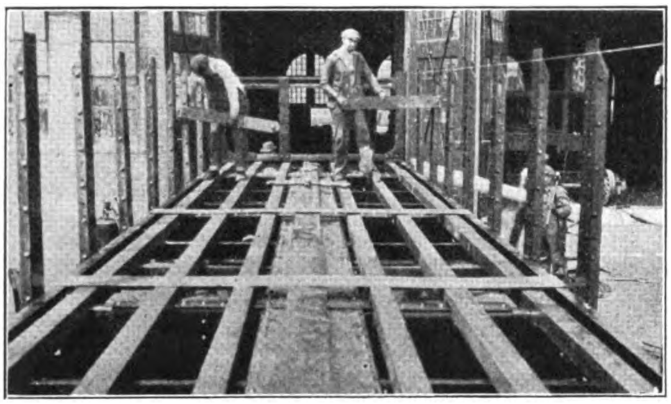
The cars of this series are equipped with Miner A-24-S friction draft gears and but few of the gears have received attention since application. After removing the

couplers and draft gear, it was decided to replace the old Simplex couplers with A. R. A. type "D" couplers and it was found that the gear on one end of the car had been recently worked and did not need attention. The other end, however, needed a new barrel, and the assembling of a new barrel and gear, which was planned to be done by the apprentices, was not carried out because no new barrels were on hand. A gear already assembled was used.

Westinghouse type "K" triple valves and centrifugal dust collectors are standard on these cars but this car came in without a dust collector and with a New York triple valve. It was necessary to make the proper repairs on these parts. The brake pipe was in fair condition and only a few fittings were necessary. Two repaired air hose and two repaired angle cocks were applied and the car was tested and found satisfactory except for the piston travel which was adjusted to the proper length.

A programmed A. F. E. on these cars calls for the application of new needle beams and side stakes. Inspection showed that the two left hand needle beams should be renewed; both end sills required straightening, and one new end sill cover plate was necessary.

Using the Red Devil rivet cutters, the old stakes, needle beams and bolsters were cut out. In some cases it was necessary for one of the apprentices to cut out rivets with an acetylene torch. The four sections of the new body bolsters and the two needle beams were first placed and fitted up for riveting. Then the sixteen intermediate side stakes and four needle beam side stakes were placed and fitted up for riveting. After all these were riveted, the end sills were straightened and one new end sill cover plate fitted up and riveted in place.



Nailers in and bolted down—Tie straps in place

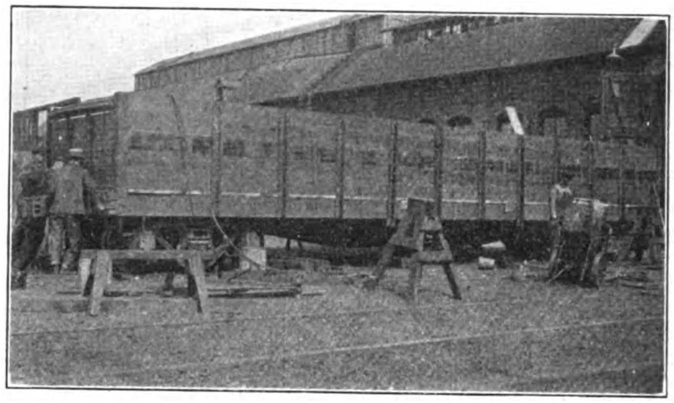
As soon as the steel work was completed, the underframe was spray painted, the nailers bolted down and new decking nailed down. One end of the car was then lowered on its truck. The side boards were bolted in place, being pulled down by a hook and chain running over the top angle iron. While the side boards were being applied, the end boards were fitted in place. The bolt holes in the side and end boards were drilled with an air motor and the nuts were run up by hand. The other truck was then put in place, its application having been delayed due to the necessity of re-driving some tie bar rivets.

As soon as the side and end boards were fixed in place the miscellaneous items such as grab irons, brake steps, coupler pin lifter, etc., were applied and the car was ready for painting. The side and end boards had received one coat of paint prior to application and the car was given another coat of paint the afternoon the mechanical work was completed. A third coat of paint was sprayed on the next day and it was allowed to dry a full day before the stenciling was applied.

Log of repairs

1—Time of start	8:15 a.m. May 11
2—Air brake equipment and piping removed	8:30 a.m. May 11
3—Side stakes cut off	8:45 a.m. May 11
4—Trucks out—car on horses	9:00 a.m. May 11
5—Draft gear dropped	9:30 a.m. May 11
6—Bolsters and needle beams cut out	11:00 a.m. May 11
7—Draft gear applied	2:30 p.m. May 11
8—Bolsters and needle beams applied	3:00 p.m. May 12
9—New stakes applied	3:30 p.m. May 12
10—Trucks ready for application	3:30 p.m. May 12
11—Trucks under car	8.30 a.m. May 13
12—Nailers bolted in	2.30 p.m. May 13
13—Decking down	4:00 p.m. May 13
14—Air brake equipment applied	10:30 a.m. May 14
15—Air brakes tested O. K.	1:15 p.m. May 14
16—Side boards in place	2:30 p.m. May 14
17—End boards in place	3:00 p.m. May 14
18—Safety appliances on	3:00 p.m. May 14
19—First coat of paint on	4:00 p.m. May 14
20—Second coat of paint on	9:15 a.m. May 15
21—Stencilling completed and car out	10:30 a.m. May 16

Under the standard schedule for determining the classification of freight car repairs, car 27,125 received Class 1 repairs, which required the following operations:



Side and end boards in place ready for drilling and bolting

A—New roof.
B—New siding complete.
C—New deck complete.
D—Two or more longitudinal sills.
E—Posts and braces renewed complete.
F—Side plank on gondola cars renewed complete.
G—Steel longitudinal sills two or more straightened or renewed.
H—100 or more rivets renewed.
I—Repaint and stencil complete.

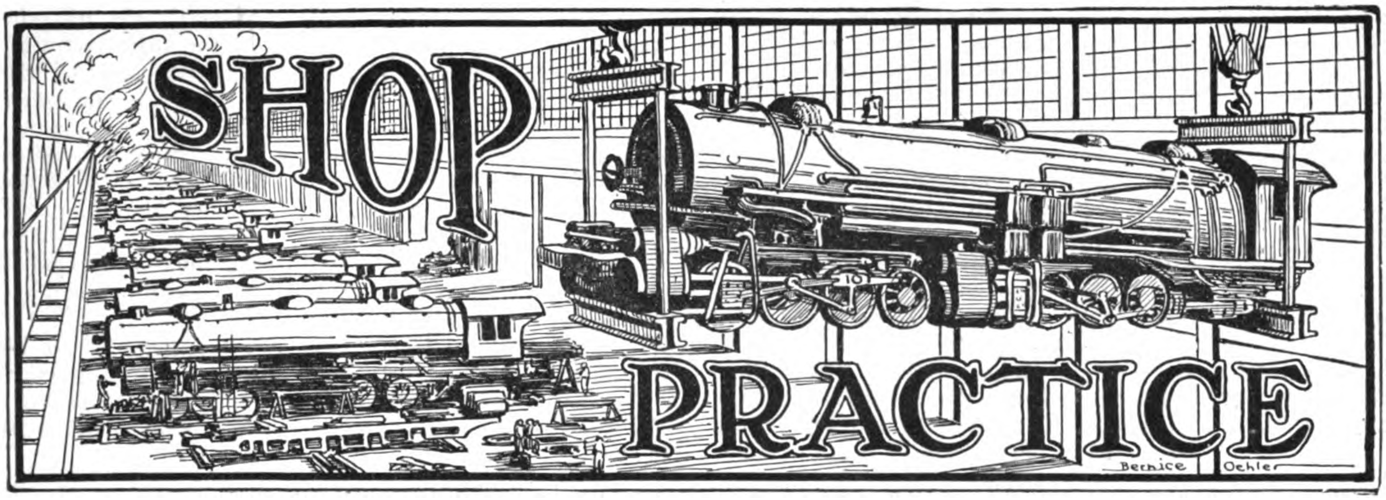
Note—Necessary air brake and truck repairs must be made to secure this classification.

Form 505 report of repairs incorporated in this report shows in detail the new parts and repair work on the car and the cost, a detail of which is given below:

Stencilling the car

	Labor	Material	Total
General repairs	$175.76	$668.70	$844.46
Replacing in kind	....	12.76	12.76
Additions and betterments	9.40	14.12	23.52
	$185.16	$695.58	$880.74

The car after being completed was inspected and approved for service.



Distribution of overhead charges in locomotive shops

Cost per hour to operate a machine suggested as accurate basis on which to distribute total overhead costs

By W. A. Jones
London, England

IN considering the question of overhead charges as applied to locomotive shops, three of the outstanding features that have never failed to appeal to the writer have been: first, the vague notions held in many cases as to what such charges consist of; second, the high proportion that such charges form of the total cost of a locomotive; and third, the varied and diverse methods by which they are included in the accounts.

Equally with his fellow engineers in other lines of business, the locomotive engineer cannot fail to have at least some interest in the cost of his product and, at the risk of being considered too elementary, it may not be unfruitful if I refer somewhat lightly to these three points. Before doing so, however, it will not be inopportune at this stage to record an opinion freely expressed to the effect that accuracy in costs is by no means so important in the locomotive industry as in those branches of industry where competition is more keen. With this view it is difficult to agree, since the necessity for reducing expenditure has never been more strongly urged on railway executives than it is at the present time. This has led to a number of cases of work being given to outside repair shops that have always been carried out in the locomotive shops. It needs no emphasis to show that the locomotive shops that are able to produce and substantiate the costs of production will be in a much stronger position to meet competition of this nature.

What overhead charges consist of

Reverting back then to the first of these points. Overhead charges may broadly be considered as every item of expense pertaining to the running of a works other than the actual material used, and the direct wages expended, on productive orders. As an example, an operator turning up a pair of drivers will have a definite price paid him for his labor and which will, as a matter of course, be debited as a direct charge against the cost of the wheels. The upkeep of the lathe, apart from the original capital outlay involved in its provision, use of power, cost of supervision, etc., all have to be reckoned with and fall under the heading of overhead charges.

Of the second point, it may be a matter of surprise to learn that in a self-contained locomotive shop making its own castings, forgings, etc., the overhead charges not infrequently, amount to no less than 40 per cent of the gross cost of a locomotive. At the same time we must consider the heavy and expensive nature of the plant necessary for the production of locomotives. In a recent case of an order going through a large locomotive works for a number of 4-6-0 superheater passenger locomotives, the total cost of which amounted to approximately $25,000 each, the overhead charges worked out at $9,750 each. When it is realized that this sum is higher by about 50 per cent than the cost of raw material, the importance of not only a true understanding, but the necessity for a close watch on such expenses will be readily appreciated.

Reference to the third point; viz., the allocation of such charges, may reasonably be left to a later stage and, without further introduction, let us consider the main items of expense that are normally classified under this heading. These are:

1—Cost of power.
2—Rent and rates of buildings, together with the lighting and necessary heating.
3—Maintenance of the plant.
4—Maintenance of buildings.
5—Depreciation.
6—Clerical and supervisory staff.
7—Laborers.
8—Transport charges i. e., cranes, yard locomotives, etc.

Reviewing for a moment our previous example of an

operator turning a pair of drivers, he will doubtless require among other things, the use of a crane to put them in and out of his machine, the assistance of laborers, while the wheels will most probably be brought into the shop on trucks drawn by a works locomotive. All these services have to be paid for and require debiting in as equitable a manner as possible. In many establishments, it is the custom to total these expenses and charge them to the costs as a percentage of the direct wages. For a works producing one type of product this method is doubtless satisfactory, but where the product itself is varied and the tools used in getting out the product are different for each of the various units produced, as for instance a flanging press in the boiler shop and an engine lathe in the machine shop, this method of distributing overhead is both incorrect and misleading in its final figures. There is no more justification for considering that a dollar's worth of labor actually applied to a locomotive part should always take the same percentage of expense than there is for the assumption that a tire mill and a drilling machine cost the same either in initial expenditure or operating cost. With the same reasoning, one would say that the overhead cost of maintaining repair benches and assembly floors is the same as for maintaining and operating machines, obviously an incorrect hypothesis.

Allied to the above method is the one whereby the expenses are charged according to the numbers of hours spent on the respective jobs. This method is subject to the same criticism in that the assumption is made that the overhead expenses have a fixed ratio to the hours spent on a job. Granted that a certain portion of such expenses as supervision, insurance, time clerks, etc., can reasonably be considered as proportionate to the time spent, these in themselves form only a minor portion of the gross charges. Moreover, an employer does not necessarily reduce his clerical and supervisory staff every time business falls off to such a point that he has to lay off some of his men, and the hourly cost would, therefore, vary sufficiently to nullify any advantage claimed. Particularly is this so when this advantage consists chiefly in compensating for the difference in wage rates by substituting hours worked for wages paid.

It will be observed that each of these methods, instead of dealing with the overhead charges as a separate entry, link them up with either the direct wages or the time spent, and any fluctuation in these will at once alter the amount of overhead debited to any particular job. This viewpoint is emphasized by the following illustration. In one locomotive works it was the practice to vary the prices paid for any given job according to the standard rate of the operator engaged on it. Now, since the overhead expenses were debited as a percentage of the direct wages it will be readily understood that there was at times quite an appreciable difference in the total cost of the same article. Exactly the same type of machine was used in each case, and the time the machine was in operation was approximately the same, yet the net result of the methods was that the amount included for overhead was considerably less in the case of the job being carried out by the lower rated man. Further, when quoting for or obtaining the cost of any piece of work, the first step is usually to find the cost of the raw material used, then the direct wages spent on it, and it is surely reasonable to ask that as near as possible we should demand the same accuracy in allocating the overhead charges.

Machine hour rate used as a basis of allocating overhead charges

It was with a view to obviating the above mentioned and similar incorrect assumptions that what is known as the hourly rate method has been developed. The machine hour rate consists of distributing all the manufacturing expenses of a works by a charge to each job of the actual cost of operating the various machines and other facilities used on that particular job. This cost is not an average for the whole plant, but is as nearly as possible the actual cost of maintaining and operating each of the machines, groups of machines, or benches found in the plant.

Referring now to the main headings of expense previously enumerated, the methods of allocating them are as follows:

Cost of power—The horsepower absorbed by each machine was obtained, and the cost allocated in proportion to the total horsepower generated and the cost of production. Under this heading was also included the cost and maintenance of shafting, belting, etc.

Rents, rates, lighting, heating, insurances—The total of these expenses are divided by the number of machines and an equal amount distributed against each. In this way a charge per machine is obtained which is practically the same as the owner of a building would offer if he rented it and supplied the light and heat. It has been advocated that this charge should be debited in proportion to the floor area occupied by each machine but, in practice, the individual amount is so small as certainly not to warrant the extra clerical labor involved.

Maintenance of the plant—Standard order numbers are allocated under which all charges for repairs, etc., are collected and debited to each machine or group of machines according to the actual expense involved.

Maintenance of buildings—These expenses are debited in the same ratio as in No. 2. Included in this heading is also an allowance for depreciation, a factor by no means to be lost sight of.

Depreciation of the plant—For this purpose, the lives of the various machines are estimated, together with their value, usually scrap, at the end of this period. The purchase price of the machine, less the residual value, is then divided by the years of estimated life and an equal amount written off annually.

Clerical and supervisory staff—The total of these expenses obtained are divided equally among the number of machines. An exception is made in the case where a small group of machines require the supervision of a foreman, such as automatics, etc., and the charges are then increased accordingly.

Laborers—Each shop is considered as a self contained unit for the purpose of allocating this charge and the gross expense of each is divided equally among the various machines in each shop. The reason for this is that in such shops as the heavy machine shop, boiler shop, etc., the proportion of laborers is much higher than in those shops where the lighter work is carried out.

Transportation charges—A similar problem presents itself here as in the case of No. 6. The cost of the upkeep of cranes and lifting tackle for each shop is readily ascertained and allocated, but the remainder of the works transportation charge is debited according to the size of the shop and the type of work carried out in each.

It may at first sight appear that the foregoing methods involve a vast amount of clerical work and if an individual rate was made for each item of the plant, this undoubtedly would be the case. To obviate this, machines of approximately the same size, similar in consumption of power, etc., were grouped together for accountancy purposes and a rate used for the whole group. By this means the number of rates was kept within reasonable limits and in actual practice, very few more rates were used

than was the case when a percentage on wages figure was used for each individual shop.

An example of how the hourly machine rate is determined

An important point in connection with the allocation of expenses is that they should be based on a sufficiently long period to ensure correct results. In the particular works under review, these were tabulated every six months, and while means were provided for checking the gross amounts debited against the various jobs with the total overhead charge, very little adjustment and alteration of the rates was found necessary. Naturally, the success or otherwise of these methods depend on the amount of attention given to the division of expenses at the commencement, as unless the first rates are approximately correct, the results obtained will be so misleading as to be in effect their own condemnation. The whole process of fixing a rate will be the better understood by an actual example and for this purpose the case of a heavy steam hammer worked in conjunction with an oil furnace has been selected. This is doubtless a more complicated process than the fixing of a rate for a lathe or a fitter's bench but it will at least, serve to illustrate how a plant of this nature is dealt with. The items in question, including expenses of installation, cost \$6,000 and \$800 respectively, were given an estimated life of 40 years for the hammer and 20 years for the furnace and engaged the services of four men. For depreciation purposes, the residual value of the hammer was placed at \$400 and the furnace as nil. The various expenses were then debited as follows:

Expense	Method of debiting	Amount
Power	Proportionate to the volume of steam used; i. e., dia. × stroke of piston.	\$915.00
Oil	Gross cost divided by number of furnaces	515.00
Rent, rates, light, etc......	$\frac{\text{Total for works}}{\text{Number of units}} = \frac{\$112,000}{1,245} =$	90.00
Maintenance of plant, including provision of dies, etc..	Actual cost	945.00
Maintenance of buildings...	$\frac{\text{Total for works}}{\text{Number of units}} = \frac{\$12,700}{1,245} =$	10.00
Depreciation	Hammer $\frac{\$5,600}{40 \times 2} = \$70$; Furnace $\frac{\$800}{20 \times 2} = 20$	90.00
Clerical and supervisory staff.	$\frac{\text{Total for works}}{\text{Number of units}} = \frac{\$99,626}{1,245} =$	80.00
Laborers	$\frac{\text{Total for shop}}{\text{Number of units in shop}} = \frac{\$2,700}{30} =$	90.00
Transportation charges	$\frac{\text{Total for works}}{\text{Number of units}} = \frac{\$11,245}{1,245} =$	9.00
	Total expense	\$2,744.00
	Total hours worked during period	1,201
	Hourly rate	\$2.25

The term units is the total number of items for which the rates were required. Although the number of separate rates did not exceed 20, the hammer dealt with above forming one of a group, for purposes of illustration the data given herewith is on the basis of an individual rate being required.

From the table it will be seen that the gross indirect cost for operating this hammer and furnace amounts to \$2.25 per hour and thus for every job for which this equipment is used, according to the time spent, this addition to the direct wages must be made. The average engineer will scarcely need reminding that this is one of the most expensive portions of the plant to maintain. At the other end of the scale, however, we find that for fitters engaged on detail work at the bench, an addition of 25 cents per hour was quite sufficient to cover the whole of the indirect charges applicable to such labor. In actual practice, experience has shown that the machine hour rate method gave a much closer knowledge and control over overhead charges and enabled us to place a good deal more reliance on the cost figures that were submitted than before. I do not think it an exaggeration to say that so far as accuracy is concerned, everything favors the methods outlined here.

So far as competitive business is concerned, one does not need to think too deeply before realizing that other factors than the actual cost have to be considered when submitting quotations, but at least, it will be admitted that a true knowledge of the costs of production are undoubtedly the safest basis to work on.

In conclusion let me say that all other methods of absorbing manufacturing expenses depend in some way or other on averages, and yet there is no more reason for averaging such expenses than there would be for averaging either the material or the labor costs.

Tool for reaming crown bolt holes

By E. G. Williams

An improved type of reamer for reaming out crown bolt holes in a boiler before tapping, is shown in Fig. 1 of the sketch. The shank of the reamer has a groove which coincides with a hole drilled in the side of the sleeve. It is a difficult matter for the boilermaker to know where to set the sleeve on the shank of the reamer in order not to make the hole too large to be threaded for the next size of crown bolt. The location of the holes drilled in the side of the sleeve is such as

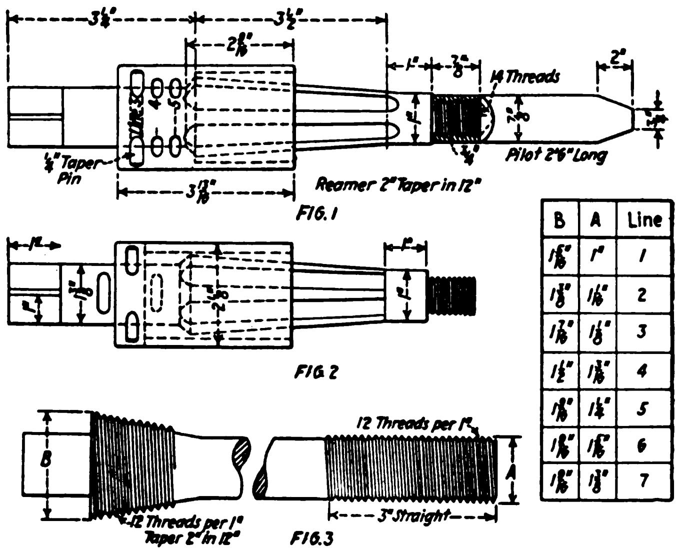


Fig. 1—A crown bolt reamer with an adjustable sleeve; Fig. 2—The old method of adjusting the reamer rather than the sleeve

to provide an accurate setting of the sleeve on the shank of the reamer. These holes are numbered to correspond with a line number of a table shown on a reference print, such as shown at the lower left hand corner of the sketch. The letters *A* and *B* of the table refer to dimensions shown in Fig. 3.

The advantage of having the line numbers on the sleeve instead of on the reamer, as shown in Fig. 2, is that the boilermaker is not so apt to make a mistake in locating the proper groove. In Fig. 1 the shank of the reamer has only one groove and the sleeve is set by

inserting the taper pin in the proper hole in the sleeve. With the old arrangement shown in Fig. 2, the sleeve has only one hole and adjustments are made by slipping the taper pin through one of the grooves on the reamer shank. It is comparatively easy to make a mistake by this method because the sleeve conceals the grooves.

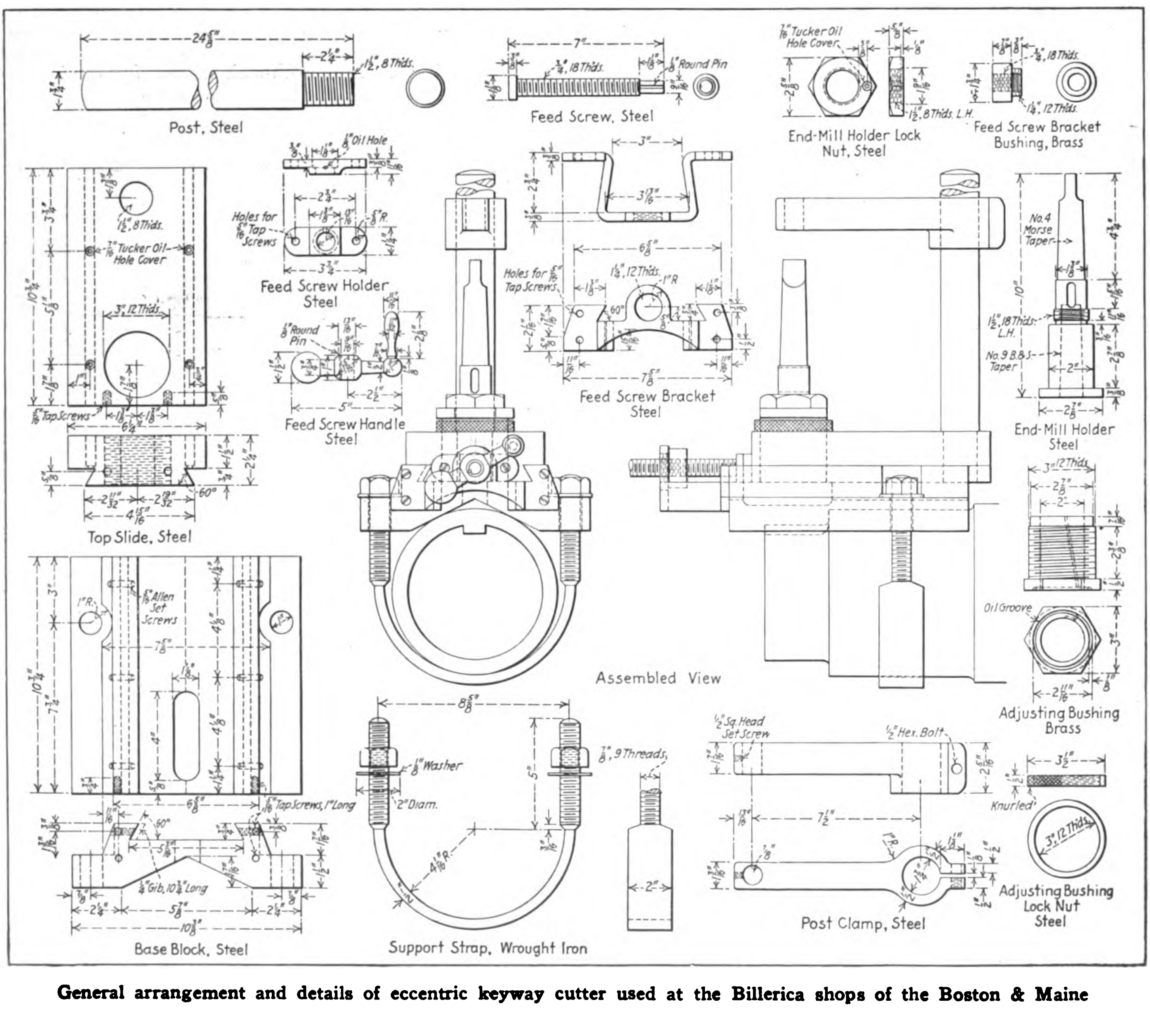
In the case of tapping holes for crown bolts, one tap is made for each line size and it is supposed to be run in flush with the sheet. This procedure, however, is not practicable for reamers as each one would be undersize after the first time it was sharpened. With this device it is only necessary after sharpening to fill the grooves on the reamer shank by electric welding and grind out a new groove to suit the sleeve.

Device for cutting keyways in eccentric pins

ONE of the troublesome jobs in connection with locomotive repair work is the cutting of new or the dressing up of old keyways in eccentric pins. To save time and labor in doing this work, there has been developed at the Billerica shops of the Boston & Maine an air operated portable key seat miller as shown in the illustration. The standard Morse taper shank is provided for attaching an air motor directly above the milling cutter. The motor is held firmly in place by a clamp attached to a 1¾-in. steel post. This arrangement eliminates vibration of the machine and gives a more smoothly milled keyway.

The end mill holder fits in the Morse shank. Fitted around the top of this holder is a steel adjusting bushing which passes through the top slide. The end mill is set to the proper depth of the keyway with this bushing and then maintained by setting the knurled lock nut. The feed is governed by the feed screw and handle at the front end of the device which moves the top slide in the base block parallel to the center line of the axle.

The tool is fastened to the axle by a ½-in. by 2-in. wrought iron U-shaped strap and two ⅞-in. tightening nuts, which draw the strap tight against the underside of the axle. The V-shaped surface of the base block of the tool provides for bringing the cutter on the center line of the axle. Provision is made for taking up all possible wear in the guides by two gibs which are adjusted by set-screws.



General arrangement and details of eccentric keyway cutter used at the Billerica shops of the Boston & Maine

Causes and prevention of pitting in locomotive boilers*

By C. H. Koyl
Engineer of water service, C. M. & St. P., Chicago

FOR many years the study of the cause of boiler pitting was handicapped by a confusion of terms between chemists and boilermen, the word cause meaning one thing to the chemist and quite another to the boilerman. The chemists were seeking for the cause of corrosion of iron, meaning by the term corrosion not only pitting and grooving in boilers but the rusting of iron in general. They sought not so much the physical causes which lead up to corrosion as they did the chemical conditions under which it takes place. They had in succession the oxide theory, the acid theory, the electrolytic theory, the biological theory, and others; but in 1922, by a continuous series of eliminations, they were finally able to agree that corrosion takes place only under water, or at least in the presence of moisture, and that its cause, or the chemical condition under which it takes place, is the presence of hydrogen ions in the water.

On the other hand the boilerman, who knows little about hydrogen ions, wants to know whether pitting is due to something in the boiler feed water, and if so, what; or to the kind of metal of which the boiler is made; or to the temperature of the feed water, or to the number and location of the injectors, or what not; always meaning by the word, cause, something under the control of the man who made the boiler, or of the man who runs it.

Accepting the statement on which all leading chemists have agreed, that pitting can take place only in the presence of hydrogen ions in the water, there yet are two distinct methods by which water becomes charged with hydrogen ions—first, by adding acid; second, by electrification. This tallies exactly with our statement of last year, founded on observation, that there are two kinds of pitting in locomotive boilers, one due to acid and the other due to electric action. But, for the boilerman, there are seven or eight conditions of water or metal to be guarded against under these two general headings.

Pitting caused by acids

Pitting by sulphuric acid, which in this country can best be observed in the vicinity of the eastern coal mines, is very characteristic in locomotive boilers. It always starts about the firebox, where both iron and water are the hottest. It shows its first effect where the surface of the metal has been weakened by bending, punching or heavy hammering, and gradually works forward, so that in the course of time it may reach the front of the boiler. Therefore, from our point of view, water contaminated by the eastern coal mines is to be avoided as one cause of pitting.

Water from swamps and stagnant ponds, and decomposing sewage, none of which are acid in the cold, will yet pit boilers because they are converted to acids by the heat of the boiler. Therefore, to the boilerman, water from these sources are to be avoided as a second cause of pitting.

When the acid in the water is very weak, it has been noticed that the only parts of the boiler affected are those where the smooth surface of the metal has been broken or weakened by rough handling. It may be by scratching a flue as it is worked through the flue sheet; it may be by excessive rolling near the flue end; it may even be by rusting in the open air; but whatever the cause of breaking the hard smooth finish on the steel, it is to be avoided as a third cause of pitting.

Every one knows that the chemical action of acid can be prevented by neutralizing the acid by lime and soda-ash before the water goes to the boiler. On the C. M. & St. P. there is some pitting due to the above causes, but not much. Most of our pitting is on the electric order.

Pitting caused by electric action

Electric pitting in locomotive boilers is also very distinctive in character. It commences at the front end of the boiler where the water comes in, and follows the course of the water toward the firebox though the pitting seldom reaches more than half way back. In its early stages it is found only on the three outer rows of flues, on the front belly plate, and on the front ends of the flues near the flue sheet, but it gradually works toward the firebox.

Also, this kind of pitting is found only in boilers fed with water rich in sodium sulphate or sodium chloride, say 20 grains per gallon as the water goes to the boiler. These alkali salts are chemically neutral to iron at boiler temperatures, but are good electrolytes, that is, they make easy the passage of an electric current through the water; and these circumstances are the starting point for the belief that in this case the hydrogen ions necessary for pitting are the result of electric action.

Furthermore, of late years it has been apparent that electric pitting is of very small amount unless there is oxygen in the water. The reason for this is that in electric pitting the atoms of metallic iron must be dissolved in the water, and since water can hold in solution only an infinitesimal quantity of iron the water would soon become saturated and the pitting cease unless something in the water continuously combined with the iron to take it out of the water and leave room for more iron. This something is oxygen.

Causes and prevention of electric pitting

Therefore, for electric pitting there must exist simultaneously three causes or conditions—electric potential from the iron to the water, alkali electrolyte in the water, and oxygen in the water. If we can eliminate any one of these three conditions we can prevent electric pitting.

For practical purposes we may at once give up hope of getting rid of alkali water, because on the Great Plains between us and the Rocky Mountains there are many thousands of square miles with no other kind of water. It is true that I can show you in print, and signed by a famous man, the proposal to evaporate all this water and then condense it for locomotive use; and it is also true that the chemist of a leading railroad proposed about the same time to freeze all this water and store the ice for

* Abstract of a paper presented before one of the Master Mechanics' staff meetings of the Chicago, Milwaukee & St. Paul.

locomotive use. Each method would give us nearly pure water, yet either would cost too much. Therefore our efforts for prevention of electric pitting must be limited to the elimination of either electric potential or oxygen.

It is a known fact that between any two pieces of metal under water there is a tendency to an electric current if they differ in chemical constitution or in physical condi-tition even the smallest amount. Steel is composed of iron and several other elements and under high-speed manufacture cannot possibly be absolutely uniform in texture and in hardness over the surface of even one flue. There are bound to be spots from which small electric currents tend to flow to other nearby spots, and if they do flow, they take atoms of iron with them, and the result is holes or pits in the steel. This kind of action is known as electrolysis, and its cause is inherent in the steel.

Other metals, such as wrought iron and copper, are more uniform in texture than steel, and both have been tested in boilers and found to pit less. But in addition to the greater cost, there are other reasons why neither of these metals has come into general us for boiler sheets or flues.

It has also been found that if an electric battery is carried on the engine, with its positive pole connected to the water and its negative pole to the boiler shell, the water can be kept at a higher electric potential than the metal which eliminates electrolytic currents and pitting is stopped.

But all these more or less expensive or cumbersome remedies have been held in abeyance because it became evident a few days ago that we had not learned all that was to be known about electrolytic pitting. As already stated, this kind of pitting shows principally on the front half of the boiler. But presumably the steel is of the same kind from one end of the boiler to the other, and, if electrolytic pitting were controlled entirely by the quality of the steel, pitting should be uniform throughout the boiler. Also the flues at the hot end of the boiler are held in the flue sheet by copper shims, and if, pitting were due entirely to difference of metal, then steel flues should pit most rapidly in contact with copper; but they do not.

Eliminating oxygen in the feedwater

Evidently the presence of alkali water and of the electrolytic difference of potential between hard spots and soft spots on steel, and between steel flues and copper shims are not enough to produce pitting. It is just as evident that the third and necessary factor is in the water when it comes through the boiler check valve, and is used up when the water is half way back to the firebox. The discovery and proof of this third factor is the key to the prevention of electrolytic pitting.

At first it was thought that a difference of electric potential between the boiler metal and water existed when the water entered the boiler, and might be sufficient to last until the water was half way back, and thus explain pitting on the front half of the flues and none on the back half. This electric charge, positive on the metal, negative in the water, does exist when the water has passed the boiler check valve. It is always present while the injector is in operation, but I have never found it of sufficient force or quantity to account for the pitting in the front half of the boiler. The phenomenon will require further study because it certainly has some effect on the pitting, but I am convinced that it is not the controlling factor.

The one remaining active content of the water as it enters the boiler is oxygen, and we have enough proof now to enable us to say that this small amount of oxygen, one part per hundred of the water by volume and only twelve parts per million by weight, is the factor which insures pitting in the front half of the boiler; and that there is seldom electric pitting in the back half of the boiler because there is not enough oxygen to last.

We have been a long time making this discovery because we all thought that electrolytic potential in the presence of alkali sulphate was enough, and it was only when we separated acid from alkali pitting and found the alkali pitting is confined to the front of the boiler, that we were led to study the influence of oxygen in this kind of pitting. The proof is complete when we find that the pressure of an open feedwater heater, which nearly eliminates oxygen, is sufficient practically to stop pitting in stationary boilers. Feedwater heaters for locomotives are new in the world but they are in successful use, and some of them are of the open type so that the oxygen can escape while the water is being heated. On a locomotive equipped with such a heater we have conducted a series of daily tests for two months, and find that on the average, 80 per cent of the oxygen is eliminated.

A locomotive feedwater heater saves 10 per cent of the fuel and water, and pays for itself in a year or so; and it will not be any added expense to get rid of oxygen and thus prevent nearly all electric pitting. Therefore, I say with confidence that the days of electric pitting in the Northwest are numbered.

Cleaning triple and distributing valves with kerosene*

By H. G. Myrick
Air brake foreman, Chicago & Alton

After a number of years experience in air brake repair work, the writer has seen the process of cleaning feed valves, distributing valves and triple valves develop through several stages. Both gasoline and kerosene have been used quite extensively and at the present time steam seems to be the most popular. However, for most practical purposes the writer prefers to use kerosene, or what is generally known as coal oil.

Unless gasoline is used with care and the "fire is cut" with engine oil or some other substance, it will blister the hands and arms of the workman. It is also considered to be a fire hazard and, furthermore, its cost is greater than kerosene. On the other hand, it does the work in a satisfactory manner, as it cuts the grease which often accumulates in the main piston bushing and various movable parts of a triple valve. Gasoline also performs the work much quicker than kerosene and it evaporates entirely when air is used to blow out the triple valve after it has been washed. Gasoline will evaporate if by any chance some should be left in the triple valve after it has been assembled and then forced into the test rack during mounting and testing. Kerosene tends to accumulate in the pipes, joints and elbows of the test rack which deposits the graphite lubricant behind fins and in crevices.

Steam is about as dangerous as gasoline on account of the liability of the workman being scalded. Triple valves have rubber and leather gaskets which will not stand the heat of live steam. In order to clean a triple valve it is necessary to remove the check valve case and the cylinder caps, and replace worn-out gaskets, including the rubber seat in the emergency valve. It is, therefore, impossible

* Abstract of a paper read before the St. Louis Air Brake Club, December 12, 1924.

to clean triple valves with steam in the same manner as one would clean the feed valve on a locomotive.

Proper facilities must be provided in order to use steam for cleaning purposes. Due consideration should also be given to the fact that considerable time is consumed in steaming out, cooling and extra handling. If the work is done in a small room, steam will cloud the room, making it unsafe to work in. In repair shops where from 30 to 40 triple valves are being handled each day, the problem of eliminating extra handling is an important one. Tests have shown that the steam does not loosen any of the bushings; but instead of having a dry heat, a wet heat like boiling water will result.

Some men will go to extremes in using kerosene and get so much oil soaked into the casting that it is practically impossible to blow it out. It works up into the slide valve bushings, cutting the dry graphite lubricant, which eventually gets into the test rack.

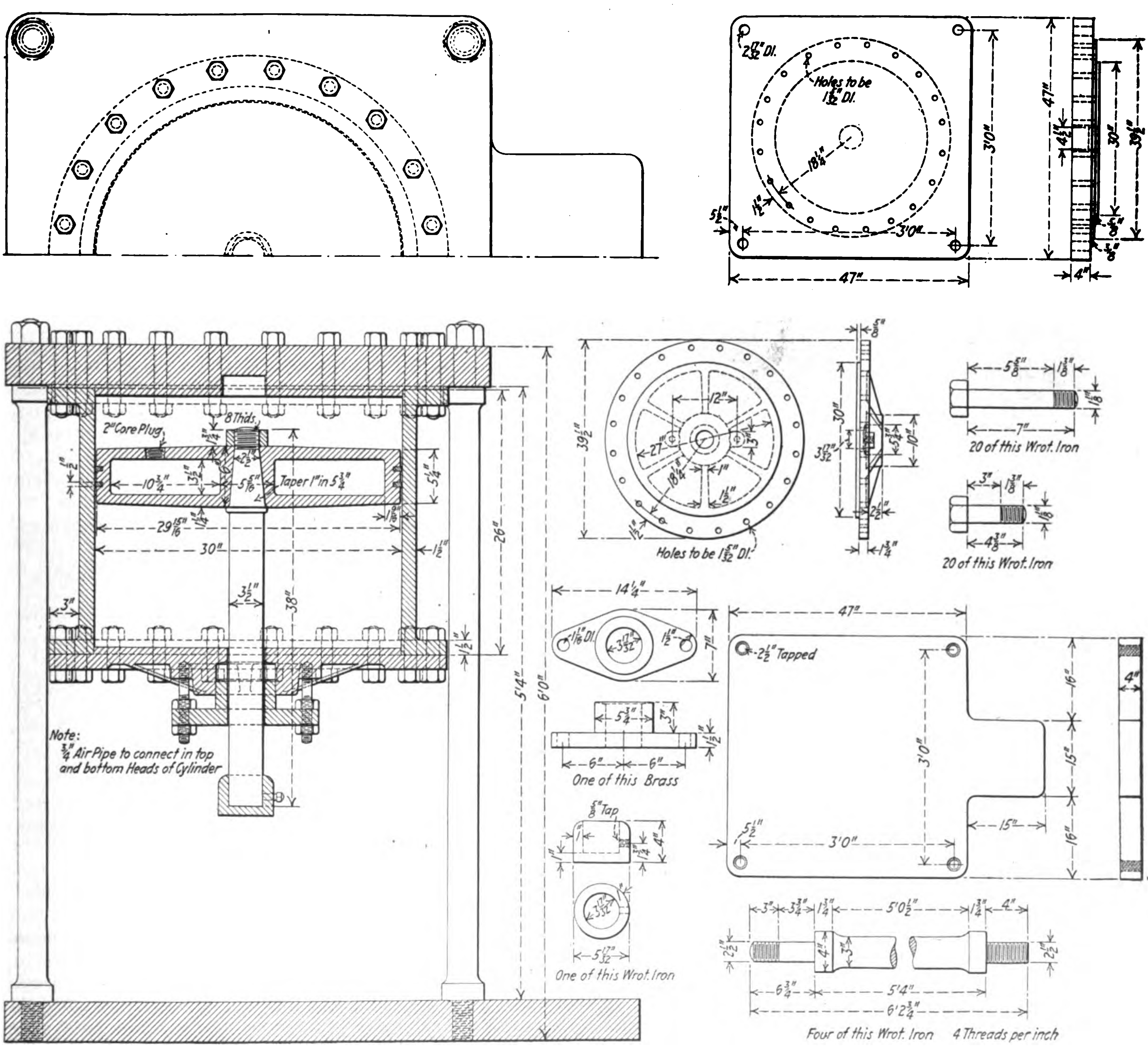
It has been found that by using a bucket or tank with sufficient kerosene in it to cover half the piston, that the oil will last the average man for one day. The bucket or tank can be emptied each evening and clean oil obtained the next morning.

A soft rag should be used to wash off all parts placed in the kerosene tank. The triple valve body should be clamped in a wire and sufficient oil squeezed from the rag to clean it out. An oak stick ¾ in. square and 14 in. long should be used to push the rag into the slide valve bushing. It does good work and protects the fingers of the workman. After washing, wipe out the oil and blow out with air, repeating the operation until the valve is thoroughly dried out. It is good practice to have an oil squirt can filled with gasoline available to flush the air passage in K and L type triple valves.

Pneumatic press for driving box shells

By E. A. Miller

A CONVENIENT type of pneumatic press that can be used to good advantage for such work as pressing in driving box shells or rod bushings is shown in the drawing. Its construction is comparatively simple, con-



Drawing showing the assembly and various parts of the pneumatic press

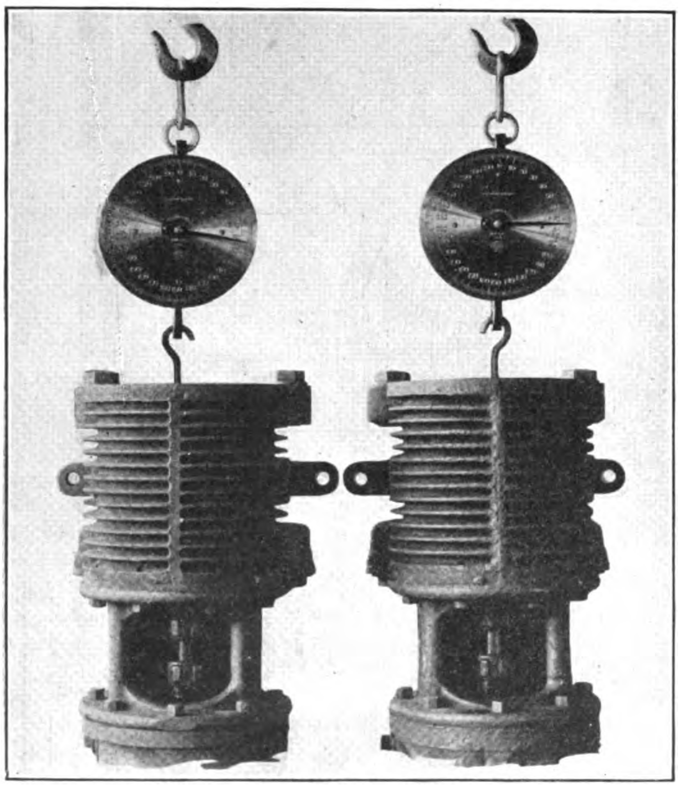
sisting essentially of a 30-in. by 24¾-in. air cylinder, a plain cast steel base and top casting to which the air cylinder is bolted. The top casting is supported on four columns, 3 in. in diameter and 5 ft. 4 in. high.

Power is furnished for pressing by admitting compressed air above the piston. Connections are provided in the top and bottom heads of the cylinder for a ¾-in. pipe which is connected to the shop air line through two control valves, one of which is for lowering the piston and the other for raising. The piston rod is 3½ in. in diameter and is secured to the piston in the usual manner, except that the shank is tapered 1 in. in 5¾ in. This distributes the pressure exerted on the piston over a greater area than would otherwise be the case if the shank were turned without a taper and the pressure of the piston were exerted entirely on the shoulder of the piston rod, which extends down through the bottom head where it serves as the ram. A shoe of wrought iron is placed on the lower end of the ram to take up the wear.

Air compressor maintenance*

THE methods of maintaining locomotive air compressors at railroad shops and enginehouses are important because on them depends the efficiency and subsequent service life of the compressors as well as the cost of the maintenance work itself.

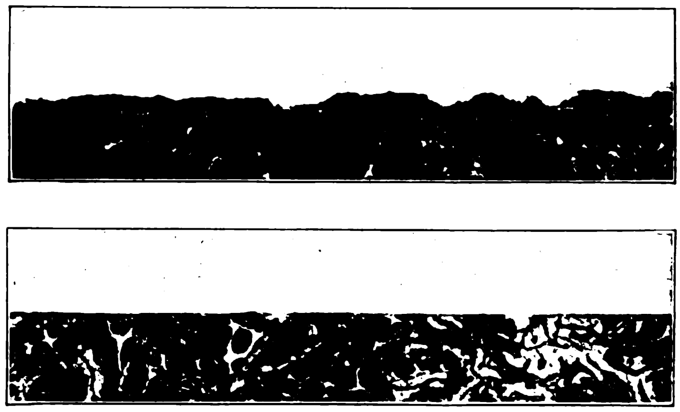
At the present time worn cylinders are commonly re-



The ground compressor (right) showed 11 per cent less pull required to lift the piston, ring and rod assembly than the bored compressor (left)

conditioned by boring, although a considerable number of grinding machines of different types have been installed within the past two or three years and have proved successful for handling this operation. When ground, the resulting cylinder surface is much superior to that obtained by boring, both in smoothness and accuracy. As the grinding wheel is composed of many thousand cutting particles it removes the necessary metal with a minimum pressure against the cylinder walls. The comparison between bored and ground surfaces afforded in two of the illustrations is significant. The superior smoothness of the ground surface means a correct seating of the rings from the start. Owing to the light pressure of the wheel against the cylinder walls, the grinding process is not affected by thick and thin walls, hard spots, etc., with the result that grinding will produce a straight and round hole without cutting away an excessive amount of stock. This minimum removal of stock means that air compressors may be reconditioned many times by grinding than is possible by boring.

Although grinding is generally admitted to be superior to boring, the factor of cylinder misalinement may still



Unretouched microphotograph of cylinder wall section, bored (above) and ground (below) which shows the smoothness obtained by grinding

be present to detract from the highest air compressor efficiency. The present common method of boring cylinders necessitates their removal from the center castings. Each cylinder or pair of cylinders is set up and bored separately and assuming that accurate centers are obtained in boring, the cylinders may be slightly out of line when reassembled either to their original or some other center casting. It should be borne in mind that taper and out-of-round conditions in the cylinders accentuate misalinement as does also the failure to draw the gasket down evenly. Misalinement not only adds to the internal friction but makes it necessary to exert considerable pressure on the stuffing box packing to prevent leaks. The correction of cylinder misalinement in air compressors is proving a real problem on some roads which have been compelled to adopt strenuous methods to secure accuracy in this detail of maintenance. The effect of cylinder misalinement is clearly shown in the drawing.

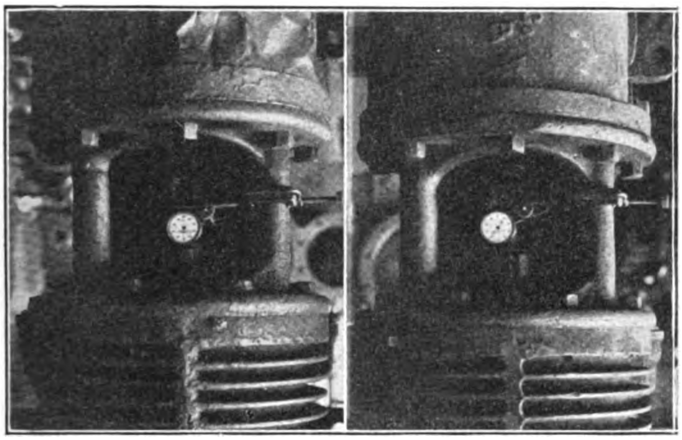
Air compressor tests

The following tests were conducted, using Westinghouse 9½-in. air compressors. Both bored and ground pumps were reconditioned to the same oversize with the same piston clearance and ring gap. The bored compressor was reconditioned in a railroad shop and when measured with inside micrometers showed 0.004 in. out of round and 0.009 in. taper in the steam cylinder, while the air cylinder was 0.008 in. out of round with 0.011 in. taper. In the ground pump both the steam and air cylinders were measured showing that they were straight and round within 0.001 in. New pistons and rods were used, the pistons being turned 0.009 in. smaller than the

* The facts pertaining to the tests described in this article were obtained from the Micro Machine Company, Davenport, Iowa.

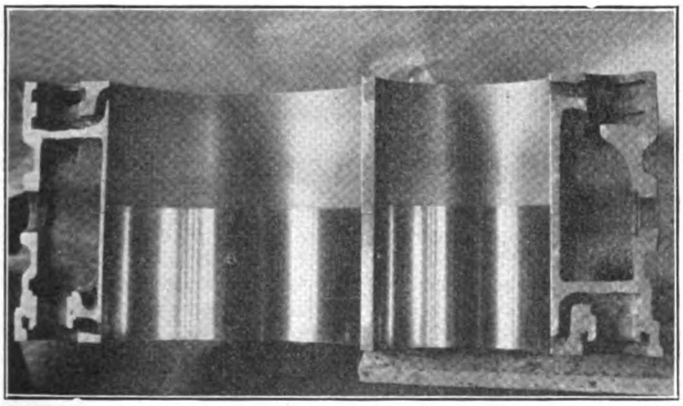
smallest diameter of the cylinder, or 0.001 in. for each inch of cylinder diameter.

In testing for alinement the pistons were assembled in the compressors without rings and an indicator was clamped to the center casting playing on the piston rod as illustrated. In pushing the pistons back and forth the indicator showed a misalinement of 0.010 in. on the bored pump and less than 0.001 in. on the ground pump. The piston, ring and rod assembly of both compressors weighed 57 lb. The pistons, rings and rods were then assembled to the cylinders, piston rod packing and stuffing box nuts being omitted. With the compressors in a vertical position a spring scale was attached to the piston and a steady upward pull exerted, also shown in one of the illustrations. The bored compressor pistons pulled at 82 lb. (or a frictional pull of 25 lb.) and the ground compressor pistons pulled at 73 lb. (or a frictional pull of 16 lb.). This showed a difference of 9 lb. or 36 per cent less frictional resistance for the ground compressor.



How the test for cylinder misalinement was made

The compressors were tested on a standard railroad test rack under pressure. In order to obtain conditions as nearly equal as possible the same steam heads were used on both compressors. The steam line carried a pressure of 135 lb. The initial test was conducted to determine the highest pressure that could be reached with the orifice closed, and the number of strokes necessary to maintain this pressure. The ground compressor reached a maximum pressure of 120 lb. and maintained this pressure with 19 strokes per minute. The bored compressor reached a maximum pressure of 115 lb. and maintained this pressure with 38 strokes per minute. This showed a saving of 50 per cent in strokes with the ground as compared with the bored compressor as well as demonstrating an ability on the part of the ground compressor to attain a higher air pressure.



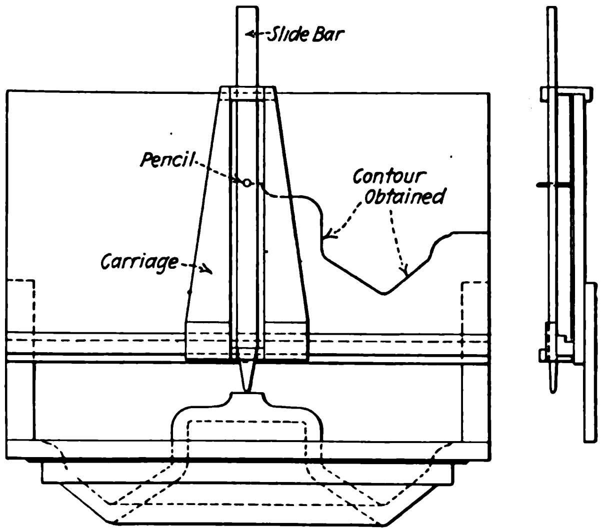
Surface comparison of bored and ground sections

The second test was conducted to determine the necessary strokes and time required to pump up to 100 lb. pressure with the air tank empty and the orifice closed. The bored compressor required 376 strokes and 4¾ min. while the ground compressor required only 320 strokes and 4½ min. The ground pump showed a reduction in strokes of 14.7 per cent and in time of ¼ min.

A third test was conducted with the 11/64-in. orifice open. The ground compressor reached a maximum pressure of 55 lb. in the drum and maintained this pressure of 104 strokes per minute. The bored compressor reached a maximum pressure of 50 lb. and remained at this pressure with 108 strokes per minute. During the test it was necessary to tighten the stuffing box nuts three times to prevent leakage with the bored compressor but this was unnecessary in the case of the one with ground cylinders. In order to ascertain the comparative difference in pressure of packing on the piston rods the heads were removed and it was found that the piston in the ground compressor could be lifted easily by hand and would drop by its own weight, while the piston in the bored compressor could not be removed without the use of a chain block.

Checking contours of cylinder head castings

SOMETIMES an engineman forgets that the cylinder cocks will let water out of the cylinders more economically than by way of the front cylinder head. There are also occasions when the rod gang in the repair shops makes a mistake and when the cylinder head is blown out, it is a difficult matter to place the blame where it belongs. A number of investigations have shown the existence of interference between the piston and cylinder head, due to incorrect contours of the cylinder head casting. In order to protect the stores department from accepting castings having wrong contours, the mechanical engineer's office had the pantograph arrangement shown in the sketch made so that the contours could be properly checked.



Apparatus by which inaccuracies in the contour of a cylinder head casting can be determined

This device, which was made in the pattern shop, con-

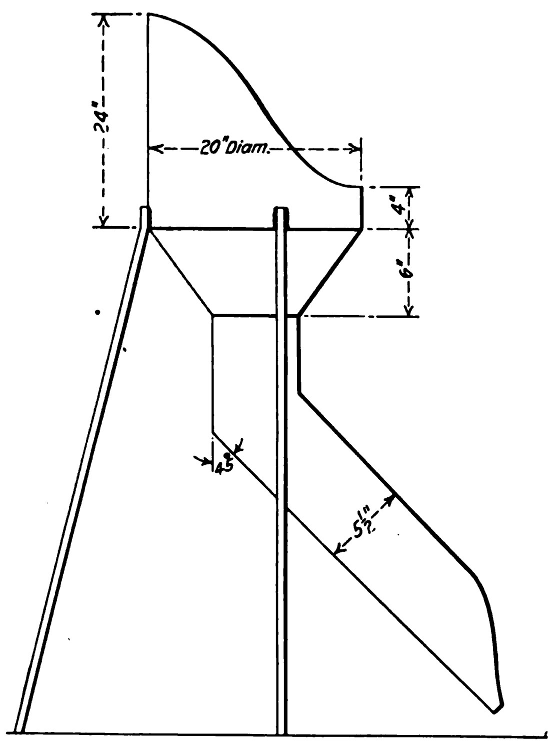
sists of a base board to which a sheet of drawing paper is fastened, and a carriage equipped with a slide bar and pencil. The carriage, shown in the sketch, carries the slide bar which moves vertically in its guides. The lower end of the slide bar is tipped with a metal point which is kept in contact with the contour of the casting as the carriage is moved while the check is being made. A pencil for scribing the contour line on the drawing paper is inserted through a hole located near the center of the slide bar.

The carriage is free to move in a horizontal direction only and the slide bar can be moved only in a vertical direction. As the carriage is moved across the face of the base board, the slide bar moves up and down as guided by the contours of the cylinder castings. These combined movements give the resulting contour line which is scribed by the pencil on the drawing paper.

Wash-out trough for the enginehouse

By Joseph Smith

THE locomotive wash-out trough shown in the sketch has given such excellent results that it has superseded the troughs that were formerly used in at least one shop. The upper portion is made of ⅛-in. steel plate, cut to form a tapering section as shown. This

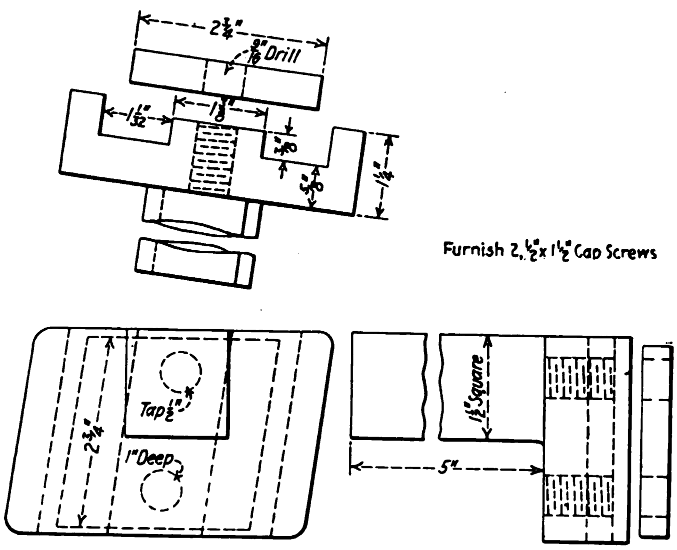


The use of this trough when washing out a locomotive has added materially to the comfort of the men

is welded to a section shaped like the frustrum of a cone while the outlet portion is made from a discarded superheater tube which is cut for the shape shown and welded to the funnel. The length of this trough can be made to suit local conditions, but it should be long enough to extend over the side of the engine pit. The trough is supported on three legs made of ¾-in. round iron, flattened out at one end and welded to the body of the trough. Two of these troughs are required, one at each front corner of the mud-ring.

Double tool holder for grooving locomotive tires

THE usual practice of cutting the tire grooves in a segmental ring is to machine them one at a time on a boring mill. In order to reduce the time required for this operation, a double-tool holder has been designed which is shown in the accompanying illustration.



Tool holder for cutting two grooves at one time in a locomotive tire

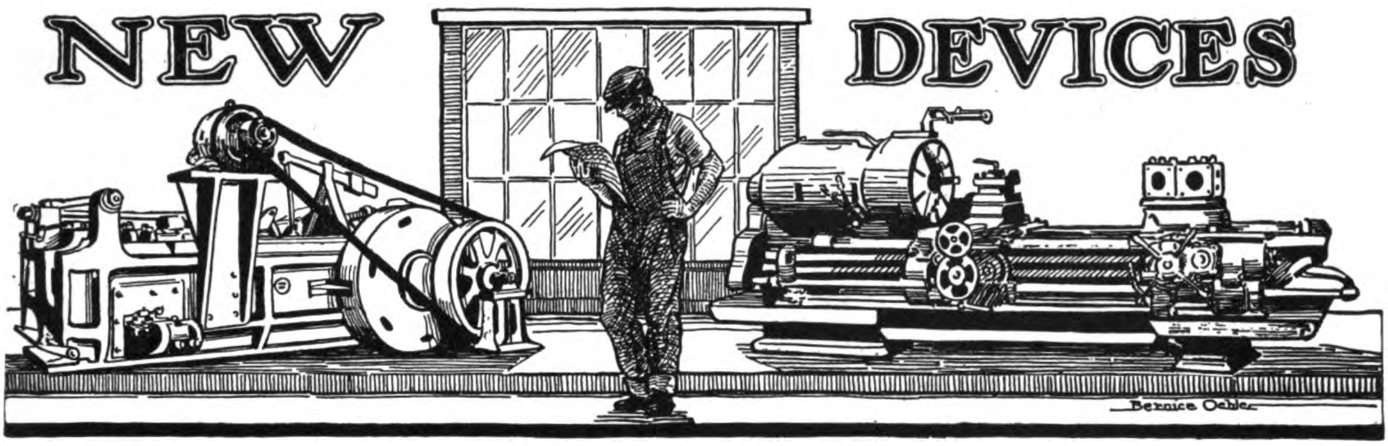
It will be noted that it is simple in construction and that it is so designed that the cutting tools are securely held in position. This allows the use of any high speed cutting tool which facilitates the depth and speed of cut.

DeWitt Rapalje, engineer of the Railroad Insurance Association, New York City, believes that many "no smoking" signs have, under existing conditions, about the same deterrent effect on railroad employees as they would have on a locomotive if tacked up on the front end of its boiler. In a paper prepared for the National Fire Protection Association, he says:

Locomotives often do a lot of smoking, but there is a more promiscuous smoker and a greater fire hazard on the railroads, and that is the careless employee. Matches and smoking, among the known causes reported annually, average over 300 fires and about half a million dollars of railroad property burned. No doubt many of the fires of "unknown" origin may belong in this group. Efforts to reduce this hazard which consist only of posting "No Smoking" signs at every conceivable point are frequently misdirected and are of about as much value as a fuel economy campaign would be which consisted of tacking a "No Smoking" sign on the front end of every locomotive.

Railroad employees generally have rough and dirty work to do as their daily task and efforts to convert them all to the non-smoking class are bound to meet with scant success. Most of them want to smoke, and they do so regardless of all the signs.

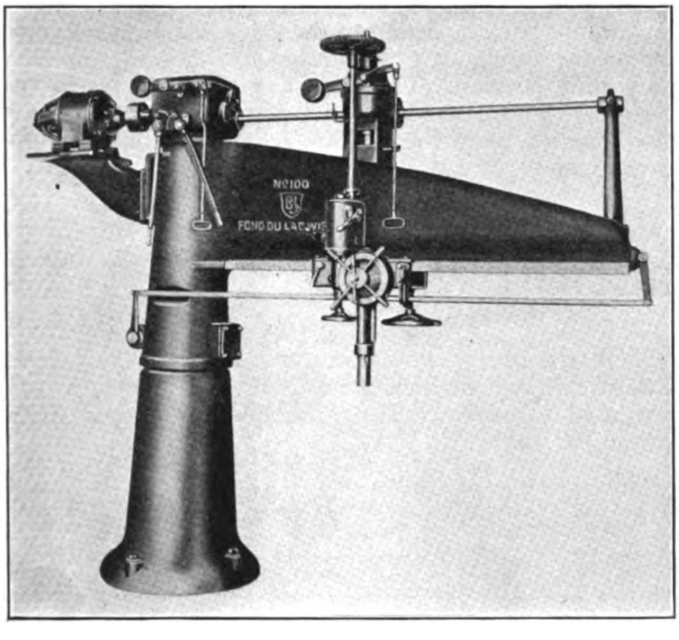
Smoking is a general habit and should be provided for by managements for employees the same as facilities are provided for passengers who smoke on trains and at stations. Provide safe and suitable smoking rooms and this serious fire hazard can be controlled. Rules against smoking can be enforced if they are applied only at the hazardous spots. The railroad record-room is a case in point. Fire inspectors are constantly reporting evidence of smoking in the typical record-room where large quantities of paper files are stored. This room generally affords one of the worst places for a cigarette butt or burning match to be left to its own inclinations. The file clerks smoke in these rooms because they can do so there without detection, while the office in which smoking might be safely indulged is filled with smoking prohibited signs.



Six-foot plain radial drill

THE 6-ft. plain radial drill shown in the illustration was designed to meet the present day requirements in boiler, car and locomotive shops. It is particularly adapted for drilling material such as tank and boiler plates. It has been designed to give ease of operation, by a convenient location of the hand wheels, lever, etc., and lower power consumption, because of the short and simple drive connections between the motor and the drill spindle.

The arm is of the hollow, box-type construction and is



Drill press designed for plate work with the control levers centralized

well ribbed. It has a movement of 360 deg. about the column. It revolves on the column in roller bearings, and a large size ball thrust bearing is used to carry the weight of the arm, thus minimizing the force necessary to move the arm to the desired drilling position. The arm is also provided with a positive opening and closing cam actuated clamp for holding it to the column and is operated by a lever mounted on the head, which is within easy reach of the operator at all times.

The motor drive is connected to the drive shaft of the speed box by means of a silent flexible Grundy coupling. The motor bracket is of the box type of construction and is adjustable to suit the different motors which may be used. Tapping can be performed on this machine by installing a reversing motor provided with a magnetic brake and control.

The speed box provides eight changes of speed for the spindle. The shafts are mounted on large size ball bearings. The sliding gear system is used to change the speeds and generous size bronze shifter shoes are employed to shift the gears. The gears run in heavy oil and are entirely enclosed by the speed case proper, the cover of which is easily removed for inspection purposes and repairs.

The spindle head is a rigid casting, well ribbed, and having long and narrow guiding ways which insure correct alinement at all times. The head is moved along the ways of the arm by means of an angular rack, worm, and generous sized hand wheel. The head can be clamped to the arm at any desired location.

The spindle is made of high carbon steel and runs in bronze bearings and is liberally supplied with oiling facilities. The thrust is taken by a large capacity ball bearing. The spindle is driven by means of a hardened steel worm and a bronze worm wheel, the worm being connected to the speed box by a shaft having a continuous keyway on which the worm slides. The worm runs in an oil bath and is mounted on ball bearings, one of which is of the double row deep groove type to take the thrust. The spindle proper has a double keyway on which is mounted a hardened steel jaw clutch, which meshes with a clutch fastened to the bronze worm wheel. The clutch on the spindle proper is shifted by means of bronze shifter shoes. The shifting lever for operating this clutch is directly in front of the operator. The entire driving mechanism is enclosed in a dust proof housing. One of the important features of this machine is that the spindle travels directly in the vertical center of the arm. By this construction all twisting strains on the arm are avoided.

The drive to the feed box is taken from the main spindle through spur gears. The drive pinion is made of steel and runs in a bronze bearing and is held in place by means of thrust washers. The driving gear is directly connected to the feed box mechanism. The pinion and gear are entirely housed but are easily accessible.

The feed box is a self-contained unit. The standard drive key construction is used to obtain the different feeds, of which there are six, having a range that is adequate to meet all needs. The changes are made by means of a

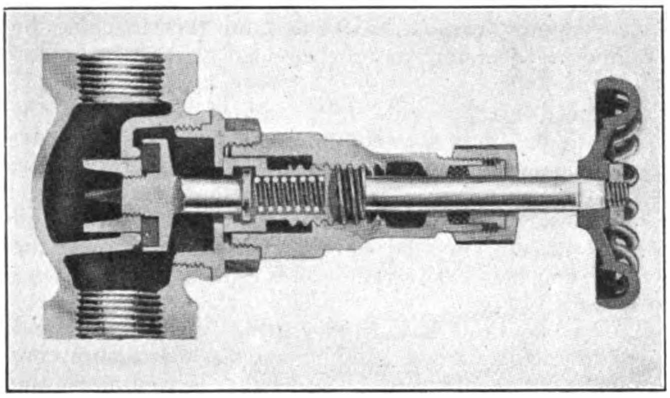
graduated dial showing the various feeds obtainable. All the shafts run in bronze bearings. A positive jaw clutch is provided for disengaging the feed.

The feed to the drill spindle is obtained through a worm, worm wheel, rack and pinion. The worm is of hardened steel and the end thrust is taken by a ball thrust bearing. The worm wheel is of cast iron and runs directly on the pinion shaft. A large friction clutch of the multiple disc type is used for engaging the power feed. A hand hole is provided for adjusting the friction clutch. The two handles of the pilot wheel when pulled toward the operator engage the feed, and when pushed away, disengage it. A hand feed wheel is also provided on the worm shaft. The feed pinion is cut directly on the shaft and is liberal in width and length. The rack is made of steel and securely fastened to the spindle sleeve.

The machine will drill holes in solid steel up to 2 in. in diameter. A 7½-hp., 1,200 r.p.m. motor is recommended. This machine is manufactured by the Giddings & Lewis Machine Tool Company, Fond du Lac, Wis.

Self seat brass valve

THE Ohio Injector Company, Wadsworth, Ohio, has recently received patents on and placed on the market a brass body valve designed for steam working pressure up to 200 lb. The principal feature of this valve is that the seat and disk are always brought into contact and held together by the same pressure, and it is so designed that this pressure can never be great enough to injure these parts. This action is altogether independent of the pressure applied to the hand wheel and it is therefore impossible to destroy the seating qualities of the valve by rough and careless operation. For this reason this valve is particularly adapted to serve where unskilled labor is employed and it also increases the life of the valve seats.



Ohio valve designed for steam pressure up to 200 lb.

Among the points of advantage which are claimed for this valve are that its area is not restricted by the extension of the stem into the seat opening; the valve body is of greater strength owing to the fact that there are only three openings in it. This valve is designed in such a manner that it will function when mounted in any position, and the perfect seating of the valve disk is not dependent on the spring or gravity to insure the disk coming to a seating position. The perfect operation of the valve is said not to be affected by the spring losing its temper or being omitted altogether. This feature is conducive to its continuous operation.

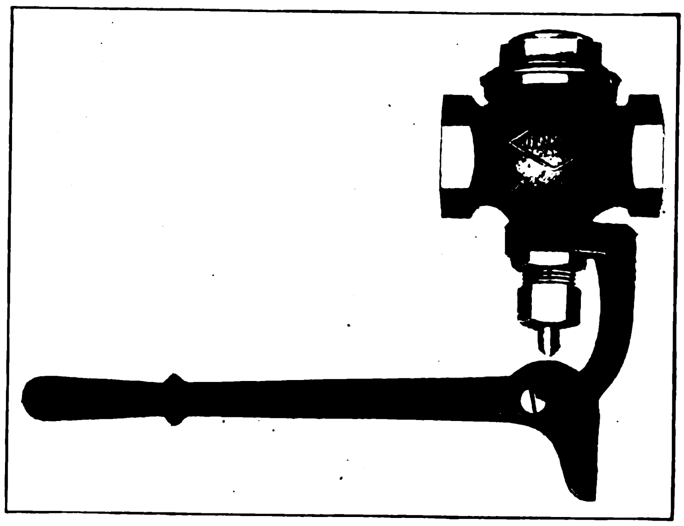
Jenkins rapid action valve

A RAPID action valve designed to fill a need for a valve that can be opened and closed instantly without water-hammer, and that will automatically stay open without the aid of set screws, locking devices or other appliances, is manufactured by the Jenkins Brothers, New York, whose specialty is all types and sizes of valves.

The hand lever, when given a pull of a quarter turn, bears on the end of the spindle which forces the disc off the seat, thus opening the valve. The lever alineing with the spindle positively holds the valve open. A slight pull on the lever, however, will throw it out of alinement with the spindle and the disc is then immediately forced onto the seat. The closing of the disc on the seat is regulated to avoid water-hammer; this being accomplished by the combination of a spring, piston, cylinder and water pressure. The avoidance of water-hammer is always desired in any installation, especially in shops and offices where the noise will annoy those at work.

The valve is made from a bronze mixture and is fitted with the Jenkins renewable composition disc. The spindle is made of steel, the yoke is steel forged, and the lever is enameled. The end of the spindle and the cam on the lever are especially hardened to prevent wear, which increases the life of the valve, which is an important feature in valve maintenance.

There are many uses for a rapid action valve in the modern railroad enginehouses, yards, and shops, it has been used to advantage, for example, on water supply lines in car yards.



Rapid action valve which automatically stays open without the aid of any other device

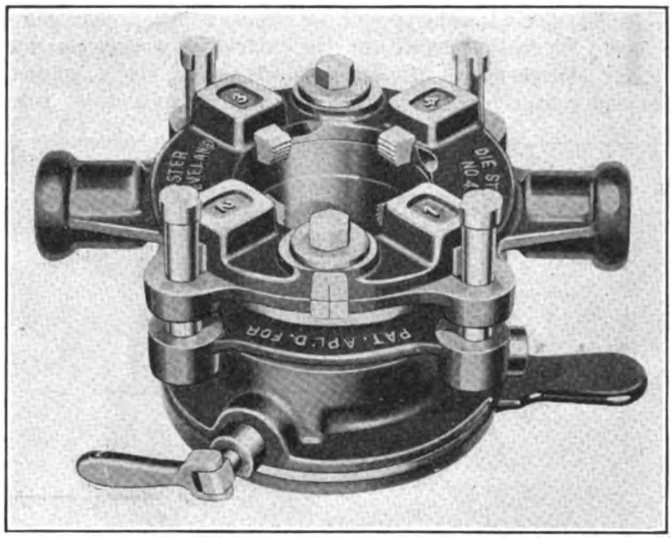
Die stock for cutting pipe threads

An easy cutting, receding die stock recently placed on the market by the Oster Manufacturing Company, Cleveland, Ohio, has several features of interest. Its capacity is one-inch to 2-inch pipe and it is made in both the plain and ratchet types.

One of the special features of this cutter is the lead on the dies which enables the operator to start them quickly and easily. A scientifically worked out cutting angle or rake brings the efficiency of the cutting edge of the dies to a maximum so that the teeth will tool out the metal with the least amount of pull on the part of the operator.

The die head of the tool is constructed so as to be quickly and easily adjusted to cut oversize or undersize as well as standard threads. The lead screw is protected from dirt and chips by a chip shield. This tends to lengthen the life of the lead screw, which is important to a tool of this type.

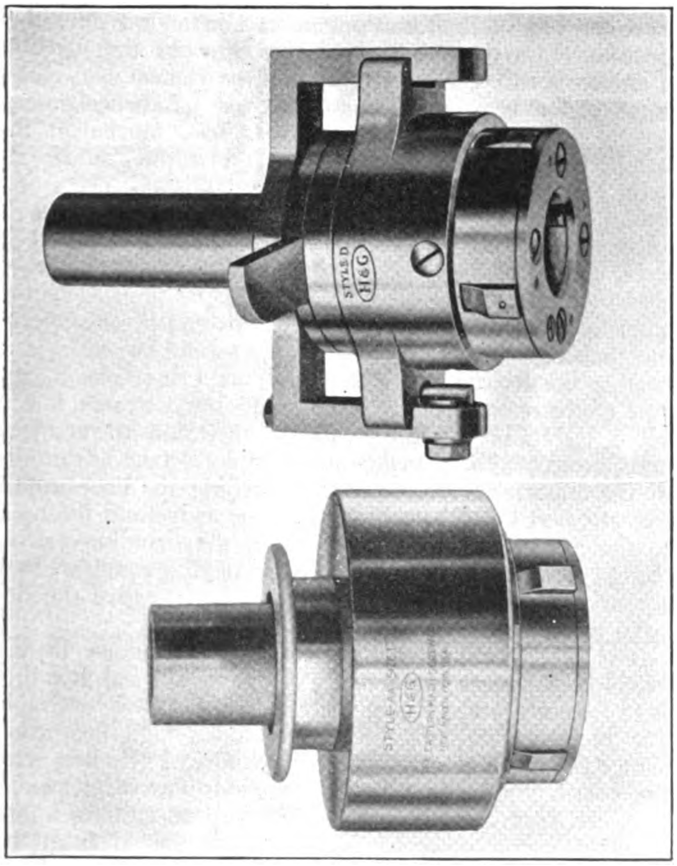
A self-centering chuck is standard equipment with the tool but it can be supplied also with bushings and set screws. The advantage of the chuck is that there are no set screws to adjust or extra bushings to carry.



The Oster easy cutting die stock uses a new type of dies

Self-opening die heads for screw machines

A SELF-OPENING die head for automatic screw machines and for threading on drill presses is the latest development of the Eastern Machine Screw Corporation, New Haven, Conn. Referring to the illustration, the upper view shows the new style AA die head designed for threading on a drill press, National Acme automatic threading machine, etc. The lower photograph shows the new style D double-drive die head especially designed for service on Brown & Sharpe automatic screw machines.



The style AA die head at the left specially adapted to machines where the die rotates and the stock does not—The style D die head at the right is provided with a double drive feature

The style D head is provided with two arms from the floating shank instead of one, which prevents any possibility of the head being thrown to one side, due to the action of threading. Both the arms and the bearing surfaces of the extensions from the shells are ground so that the drive is equally distributed, both to the top and bottom. The head is self-contained in that an accurate adjustment for the length of thread is provided on the upper arm. These heads are designed to provide a wide range of thread specifications and at the same time to simplify the cam layout, set up and general operation of the machine. It is also adaptable to Cleveland automatic screw machines.

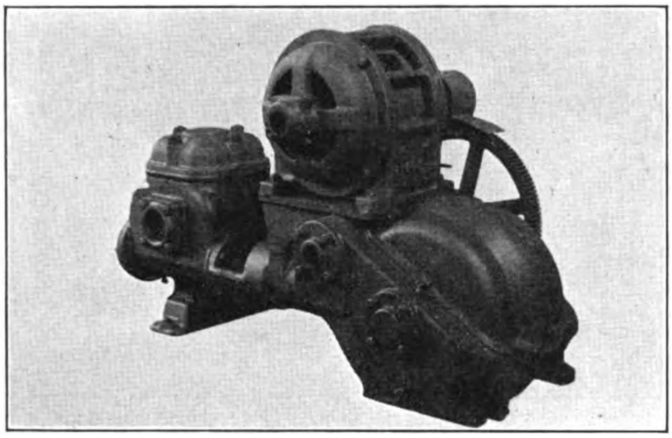
The outer sleeve of the style AA head is provided with a spool at the back to take a simple yoke. It is so designed that when the threading spindle is drawn back after a thread has been cut and the backward motion of the yoke arrested by means of a stop, the die head is automatically closed. As the die spindle advances during the threading operation, the length of thread cut is determined by a stop which arrests the forward motion of the yoke, thereby holding back the outer sleeve and causing the die head to trip.

The tripping which is of the pull-off nature is quite sensitive in its operation and makes it possible to govern the length of thread to a small fraction of the pitch. This arrangement provides a safety feature against any possibility of the head starting to thread short bar ends and refusing to let go. Only the simplest form of sliding yoke or fork is required to operate this head which is arranged with an adjustable stop on each side of its travel.

For drill press work, the shanks of the style AA head can be modified to provide the proper standard tapers to fit the spindle of the drill press. The diameter of the thread cut is adjusted by means of a micrometer adjusting screw on the front face of the tool.

Duplex enclosed flood lubricated pump

THE enclosed type of self-lubricating power pump recently placed on the market by the Gardner Governor Company, Quincy, Ill., is a general service pump for boiler feeding, water circulation, pressure boosting, water supply or any other service where a pump is required. With an installation arranged so that the pump can be operated by a float switch or remote control, the pump can be started by merely turning a switch which eliminates most of the attention required by an attendant.



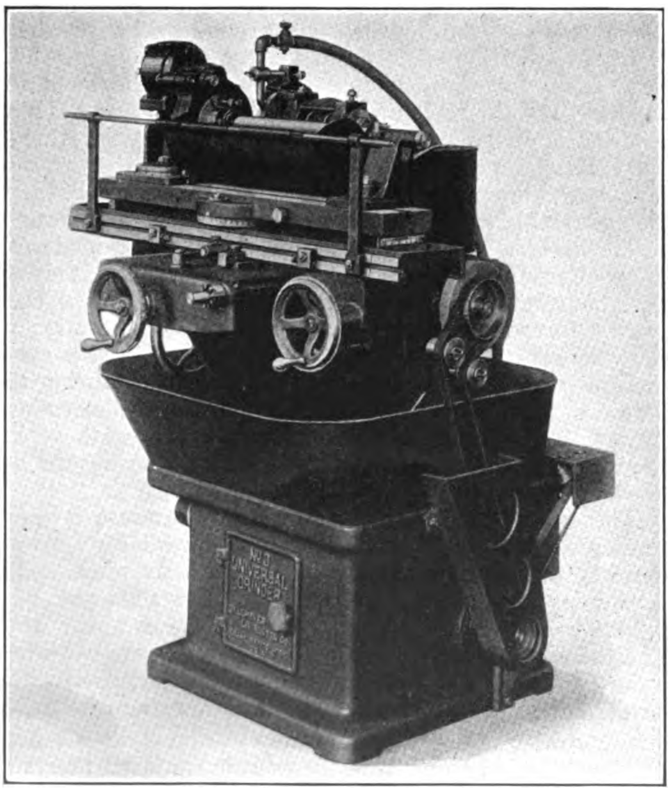
Packed piston type pump with the motor mounted on top of of the frame

All the running parts of the pump are totally enclosed in the crank case which acts as an oil reservoir for the flood lubricating system. Grease cups, oil cups and sight feed oilers have been entirely discarded. The lubricating system is automatic and positive. The main driving gear, partially submerged in oil, delivers the oil through channels to the main and pinion shaft bearings, crank and crosshead pin bearings and crosshead guides. All the working parts are flooded with oil, which insures long life and continued smooth operation.

The type of valve used is determined by the kind of liquid pumped. Medium rubber valves are recommended for cold water service and hard rubber or brass valves for hot water. The brass valves in packed pistons and outside packed pumps are light weight disc valves with a curved web. The oil line pumps have brass wing guided valves seated on a taper.

Universal cutter and tool grinder

ON page 1588 of the June 14, 1924, daily edition of the Railway Age will be found a description of a universal tool room grinder manufactured by the Gallmeyer & Livingston Company, Grand Rapids, Mich. Since the publication of this description improvements have been made on the machine, principally in the addition of a motor driven, wet grinding attachment.



Motor driven grinder provided with a power feed and a wet grinding attachment

The machine is made in two sizes, either of which can be operated from the front or the rear. Transverse, vertical and longitudinal movements can be made from either position. Furthermore, from the front of the machine a choice is offered for longitudinal movement between a rapid action lever handle and a slower handwheel movement. For both vertical and cross feed movement the hand wheels are graduated in thousandths, the graduations being coarse enough to be easily split, if necessary. Pointers with movable set collars, make the reading easy. In service, the machine can be made to perform practically every operation in either of two ways: by either having the spindle head locked in position on the central column and swivelling the sleeve knee, etc., around it, or by leaving the sleeve locked in a fixed position and swivelling the head to the desired position. Individual preference, on the part of the operator, can be the guide in most cases, but in some instances the difference in direction of artificial and natural daylight makes it desirable to take advantage of the opportunity offered for swivelling the knee saddle into the best lighted position and then swivelling the head to the proper position for effecting the grinding job in hand. One setting can be used for daylight and another for artificial illumination and each of them give the desired convenience.

The wet grinding attachment may be added to the machine or not, as preferred. Where cylindrical grinding is to be done, wet grinding is essential and it is desirable for many other jobs. The accompanying illustration shows the machine arranged for cylindrical grinding with the splash guards in place. A copious flow of water is provided from a centrifugal pump with no stuffing boxes or other parts to wear. The pump is driven from the motor shaft in the base on motor driven units, or by a belt from the countershaft on belt driven machines. Water is supplied in large volume but without sufficient pressure to cause splashing. The guards keep the water in the

machine and return it to the tank with its settling chamber ready for further use. The tank can be quickly removed for cleaning.

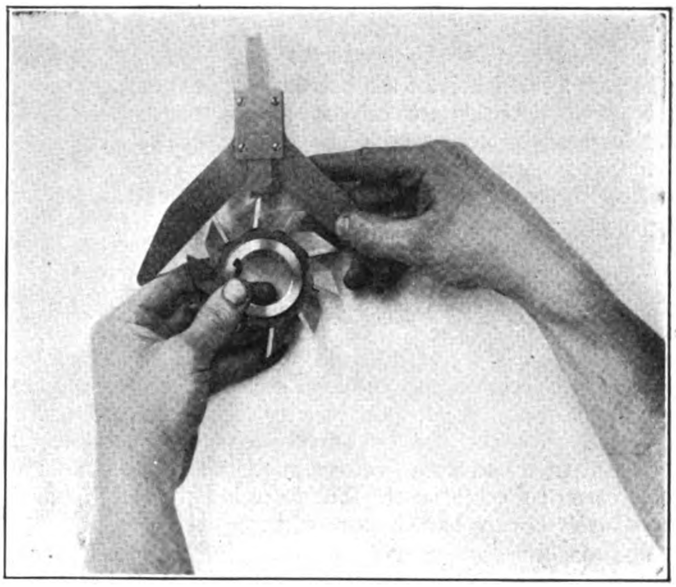
Some of the dimensions of the machine are as follows: Size of table, 5½ in. by 42 in.; longitudinal travel, 18 in.; transverse movement, 10 in.; vertical movement, 10¾ in.; maximum swing, 10½ in. by 26 in.; and maximum distance from center line of the spindle to the table, 10½ in.

Convenient tools for the tool room

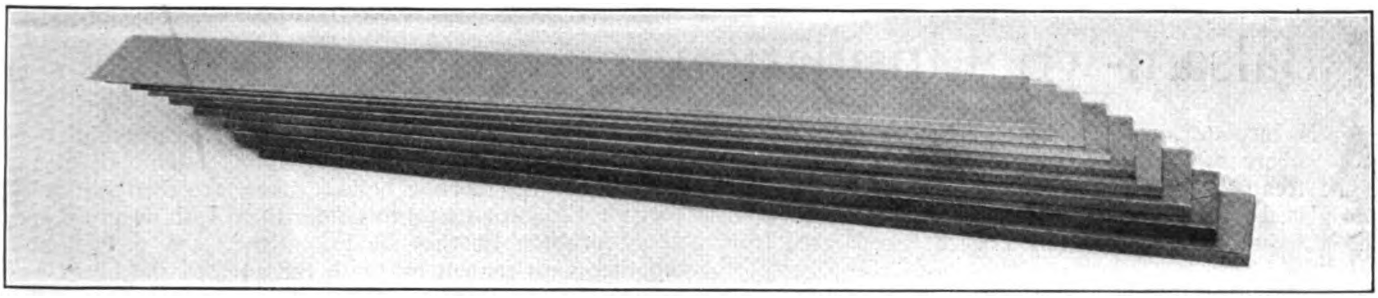
A CUTTER clearance gage and ground flat stock are recent additions made by the Brown & Sharpe Manufacturing Company, Providence, R. I., to its list of hand tools. The clearance gage is a simple device designed for the purpose of aiding in grinding the correct angle of clearance on milling cutters. It may be used for right and left hand cutters and for end mills of all styles. The vee-shape body locates the cutter and holds the gage blade in correct relation to the center line of the cutter. All contact surfaces are hardened and ground. Two gage blades are furnished, each of which is stamped at each end with the diameter of the cutters for which it is intended to be used.

The gage will measure all style cutters from ½ in. up to 8 in. in diameter, and of any width. Its use is very simple. The inside surfaces of the vee arc are brought in contact with the cutter as shown in one of the illustrations, and then the gage blade is dropped on the tooth to be gaged. The cutter is revolved sufficiently to bring the face of the tooth in contact with the gage blade. The angle of clearance in the tooth should correspond with the angle of the gage thus accurately determining whether the cutter teeth are properly cut or not.

The railroad toolroom is often required to make templates, gages and small tools from flat stock. The ground flat stock shown in the illustration is well adapted to this class of work. This stock is now available in three new thicknesses, 3/64 in.; 5/16 in.; and ⅜ in., and in six new square sizes varying from ¼ in. to 1 in. square. New widths can also be obtained from ½ in. to 6 in. in some thicknesses. This stock is made from tool steel, cut and annealed, then accurately ground to thickness. Each piece of stock is 18 in. long.



Method of using the Brown & Sharpe cutter clearance gage



Ground flat stock for use in the tool room

Heavy duty vertical boring and drilling machines

THREE sizes of heavy duty vertical boring, drilling and milling machines have recently been placed on the market by Baker Brothers, Inc., Toledo, Ohio. Size No. 525, which is shown in the accompanying illustration, is the largest of the three. In the next size, the machine has a 24-in. gap and a swing of 48-in. which makes it possible for the machine to handle a wide range of miscellaneous work for facing, tapping and drilling operations.

The machines are designed for heavy and rapid boring, drilling, facing and tapping and have ample capacity to drive high speed drills of their rated sizes to their limit of efficiency in steel. They can be used for boring and enlarging in steel and cast iron for which operations they are especially designed. Instantaneous change from drilling to reaming feed in the correct ratio is also provided.

Eight speed changes are provided which may be instantly made without stopping the machine. The drive is through a train of hardened alloy steel gears, running on high grade annular ball bearings, all enclosed in an oil-tight box. A minimum number of gears are running in mesh at any time. Twelve drilling and twelve reaming feeds are provided. The feed rack is of alloy steel as is the feed pinion which meshes with it and which is cut directly on the shaft. A large bronze worm gear with provision for securing uniform wear and a safety shear

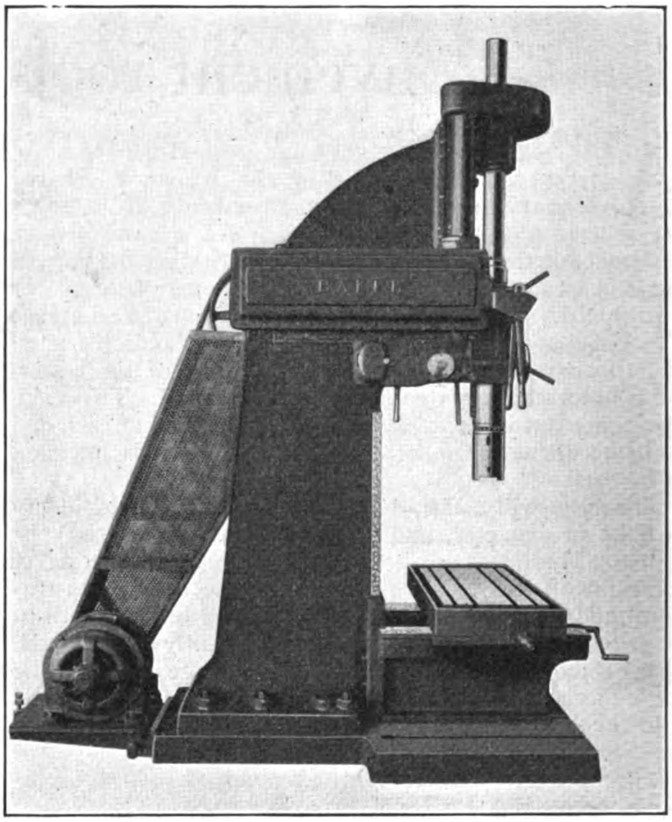
pin to protect the feeding mechanism from abuse are provided.

The spindle is of forged steel and is fitted with special chrome ball-thrust bearings. The spindle nose is bored for No. 6 Morse taper. It is slotted across the end for driving heavy boring and facing heads, fitted with a cross drift for holding these heavy tools securely and, in addition, has a hollow set screw to prevent the light tools from dropping out.

These machines have an automatic depth stop with fine adjustments. A special pair of feed change gears which may be applied at any time permits facing to an exact depth. It only requires a few seconds to apply these gears. Capstan handles are provided for rapid traverse; in addition, hand worm feed is provided.

The table, which is of the box-knee type, heavily braced and provided with unusually ample oil grooves, is raised and lowered by means of a telescoping screw. The construction is such that a 4-in. hole may be bored for supporting a boring bar of that diameter, the table being reinforced for this purpose. The bottom of the knee has the projecting edges planed parallel, permitting the use of parallel bars to take the thrust for extremely heavy work. The compound table is of the box-knee or heavy milling machine type. The adjustments are made by means of cut screws with a lead of one inch to the revolution. The operator can handle both movements simultaneously without changing his position. Furthermore, the screw adjustments may be quickly made. An ample oil pocket at each end with grooves at the sides and drainage takes care of the lubricant. The knee is bored and bushed for a lower boring bar support when desired.

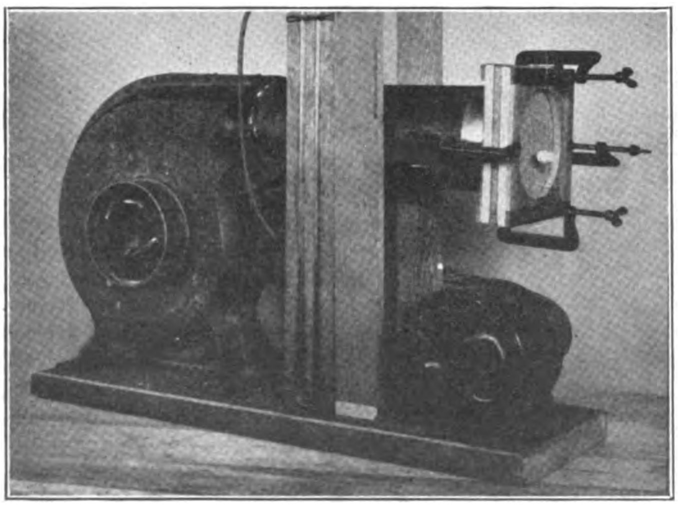
The machine can be arranged for driving direct from a motor and when so arranged, the sub-base is extended back and the motor is belted direct by means of a belt up to the machine driving pulley. The machine is started and stopped by means of shifting belt on tight and loose pulleys which run on ball bearings, a spring device holding the belt securely on or off. In the off position a brake is applied in such a manner as quickly to stop the spindle and hold it effectually stopped. A tapping reverse can be furnished if desired.



Baker 5-in. capacity vertical boring and drilling machine arranged for motor drive and equipped with a compound table

Balsam-wool insulation for refrigerator cars

An insulator, called Balsam-Wool, made from the fibers of coniferous northern woods, chemically treated to withstand refrigerator car service has been placed on the market by the Wood Conversion Company, Cloquet, Minn. The fibers are first separated from one another by chemical and mechanical means similar to those used in pulp making. The individual fibers, which are fine, hairlike hollow tubes, are then saturated with chemicals that tend to render them both fireproof and decay proof. In this condition, they are next bound together with cement but with the axes of the fibers extending in all three cubical dimensions and not parallel to each other as in wood. The result is a resilient blanket of fibers which weighs only 5 lb. per cu. ft., or less than one-half the weight of cork. It contains countless still air cells, over 94 per cent of the volume being still air.



Testing equipment designed to determine the porosity of insulators

To increase the mechanical strength of the fibrous blanket, it is covered on both sides with a layer of creped waterproof Kraft paper which is cemented to the blanket of fibers by a high melting point asphalt. This covering layer is impervious to the passage of both water and air.

Tested for thermal conductivity, the average heat flow in 24 hours through Balsam-Wool is 6.1 B.t.u. per sq. ft. per in. thickness per deg. F., some samples testing as low as 5.7. The flexible texture of this product makes it elastic, and this elastic principle is further carried out through the use of the creped Kraft paper liner which it is said can be stretched 25 per cent or more without tearing. This is a greater stretch than occurs when the top of a refrigerator car weaves 8 in. out of line.

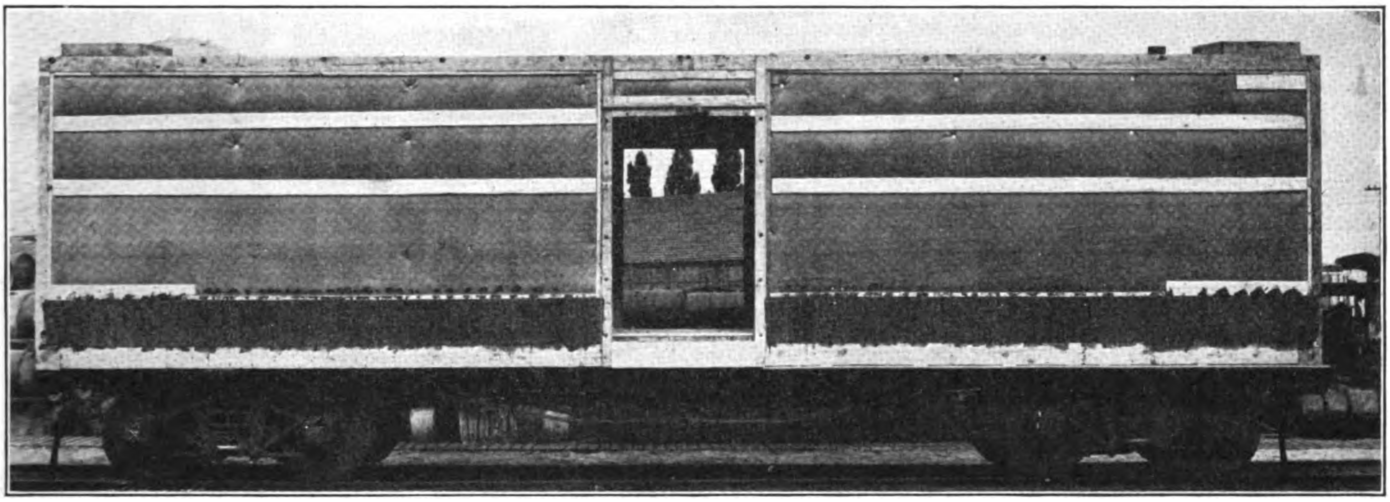
Some interesting tests of Balsam-Wool were conducted by Howard F. Weiss, research engineer of the C. F.

Burgess Laboratories, Madison, Wis., as follows: To test the resistance of the material to mechanical wear and tear, a machine was constructed on which was mounted a section of a refrigerator car side frame 8 ft. high and 4 ft. wide. To this section the insulators under test were then nailed. The machine was started and it thrust the top of the frame 8 in. out of plumb with the bottom. The whole frame at the same time being lifted and dropped 3/16 of an inch rapidly enough to give it a vibrating motion. The object sought was to duplicate as closely as possible what happens to an insulator fastened to a refrigerator car which is in bad condition and rolling over a rough track. After being subjected to many repeated thrusts and vibrations, the Balsam-Wool did not tear or shake down.

To test for porosity, an air pressure equivalent to an air velocity 40 miles an hour was maintained against one side of the insulator as illustrated, a manometer being used to indicate the pressure. The distance the cotton ball was blown from the perpendicular was used as a measure of the permeability of the insulator to air and in the case of Balsam-Wool there was no perceptible movement of the cotton ball. When inoculated with molds and fungus and placed in a warm, damp, atmosphere, no growth occurred.

The asphalt-coated liners are resistant to the passage of moisture so that the interior blanket of fibers is protected when exposed for an appreciable time to a high humidity. The tests showed that Balsam-Wool will absorb about 30 per cent moisture, or over twice as much as that of cork when subjected for a long time to a humidity of 90 per cent or more. However, at 30 per cent moisture, Balsam-Wool is said to contain less moisture per square foot than cork at 15 or 10 per cent moisture because of the former's extremely low density. Therefore, its thermal resistance, even when subjected to high and to prolonged humidity, is not seriously impaired by this condition.

The product comes in large sheets that are light in weight and can be easily cut and nailed. It is said to be possible to save 2,000 lb. or more of dead weight in the construction of a refrigerator car by the use of this insulation. About 20 cars have been equipped to date.

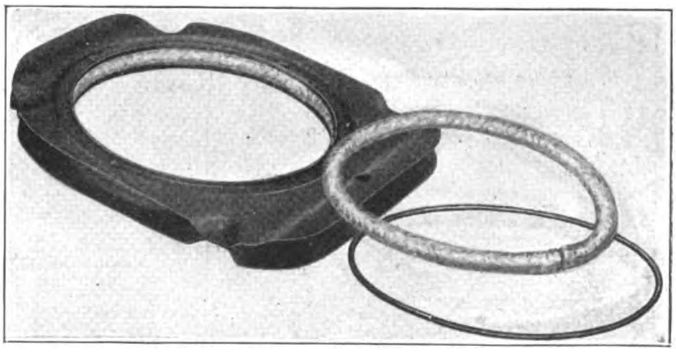


How Balsam-Wool insulation is applied to a refrigerator car

Journal box dust guard

A JOURNAL box dust guard manufactured in all sizes for freight and passenger equipment to conform to the American Railway Association standards has recently been placed on the market by the Union Asbestos & Rubber Company, Chicago. The purpose of the design is to maintain an oil-retaining and dust-proof joint around the axle and the side of the dust guard chamber.

Its construction differs somewhat from the usual design of dust guards. The two sides of the guard are pressed from steel sheets and securely spot welded together at four points. One side plate of the guard is so formed as to act as a spring and forces the opposite side tightly against the oil and packing retaining wall of the journal box. This arrangement provides a dust-proof joint between the dust guard and the side of the dust guard chamber and makes it self-supporting in the box, eliminating continuous and uneven wear at the top of the bore of the guard, as is the case where it rides on the axle. A special asbestos packing ring, inserted in the groove formed in the guard, is automatically held in close contact with the axle at all points on its circumference by means of a circular steel spring.



Dust guard pressed from steel sheets—An asbestos packing ring is used

Compact high speed electric hoist

A COMPACT, high speed electric hoist has been added to its line of products by the Roeper Crane and Hoist Works, Reading, Pa. The worm is placed above the gear. This is the reverse of the usual worm gear drive on most tools and is said to remove the cause of considerable wear. The worm shaft is equipped with a ball end thrust bearing.

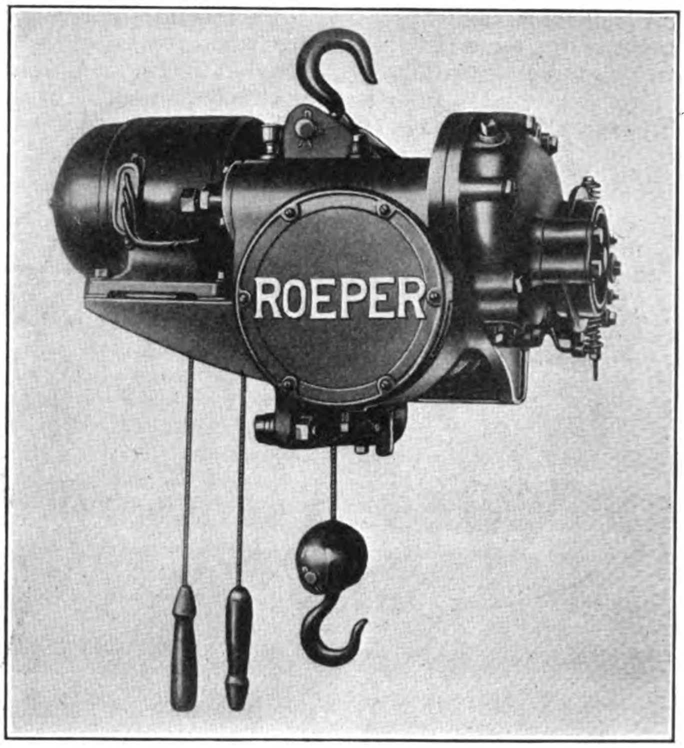
The motor is mounted on its feet directly upon an extension of the hoist frame. The main frame of the hoist is a one-piece casting that contains all the bearings so that shafts and moving parts, once assembled, cannot get out of alinement.

Steel suspension plates, reaching from the drum shaft to the overhead suspension members, relieve all tension on the castings and provide a means for a hook, link, clevice or any special form of suspension. An automatic stop of the trip lever type, positive in its action, affords protection in extreme lifting and lowering. This stop can be adjusted for any distance of hook travel.

The need of a load brake is removed by the worm drive. The motor is equipped with a mechanically operated jaw brake acting in series with the controller, which brings the motor to a quick stop, preventing drifting of the load when the power is cut off.

The controllers are of the single-speed drum type of standard design. For this control, the motor is equipped with an electric magnetic brake and an adjustable upper and lower electric limit switch.

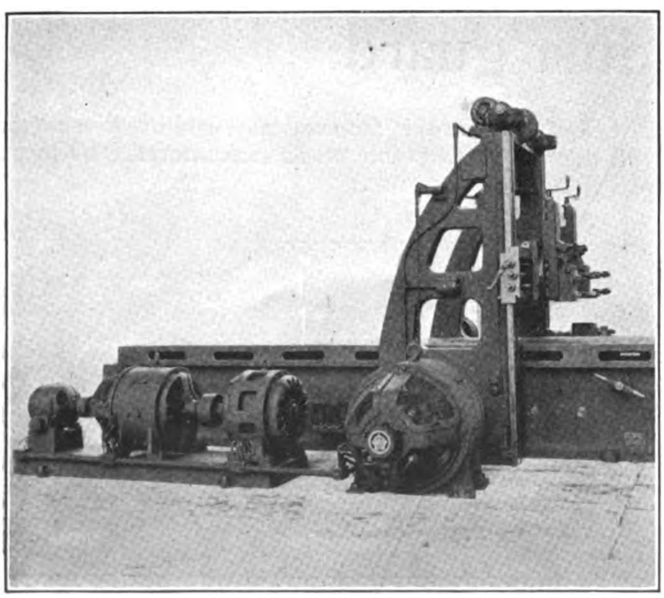
While the illustration shows a hoist for hook suspension, it can also be furnished with either plain or geared I-beam trolleys with roller bearing wheels. Provision is also made for direct connection of the hoist to any standard trolley for a flat rail or a special track. The hoist can be furnished in 500, 1,000 and 2,000 lb. capacities with a single strand of hoisting cable.



Roeper Type R electric hoist with the worm gear placed above the gear

Alternating current motor drive for planers

IT is now generally acknowledged that driving a planer by a direct current adjustable speed motor connected directly to the machine is superior to any type of drive through belts or clutches. This is because of the higher cutting and return speeds possible, the ease with which any cutting or return speed may be obtained, accuracy of reversal and lower maintenance cost of the reversing motor drive.



Rear view of a planer showing the reversing driving motor and motor generator set with separate excitor

The advantages of the reversing motor drive for planers have, until recently, been confined to plants having a supply of direct current. It is now possible for the plant which has only alternating current available to obtain a reversing motor drive. The equipment by which this is accomplished comprises a direct current adjustable speed reversing motor connected directly to the planer, current for which is furnished by a generator driven by a motor which uses the alternating current from the main line. The connections between the planer motor and the generator are never broken when in use, therefore a controller with a multiplicity of relays and contactors for carrying the large armature current is not required. The entire control of the planer motor for direction and speed is obtained by manipulation of the small field current of the generator. Reversal of the field current of the generator changes the direction of the generated current and hence reverses the direction of rotation of the planer motor. The reversal of the generator field is effected by an oscillating drum switch operated by dogs on the table, the contacts being closed and opened under oil in the enclosing case.

Changes in speed of the planer motor are obtained by varying the field current of the generator; reducing the field current lowers the voltage of the generated current

and hence lowers the speed of the planer motor; increasing the field current raises the voltage and the speed of the planer motor is increased. The changes in field current are obtained through separate rheostats adjusted by hand for the cutting and return strokes; any cutting speed may, therefore, be used with any return speed within the range of the equipment. The generator and driving motor are mounted on one base and may be placed in any convenient location as the only connection between the generator and the planer driving motor is by wire. With this equipment, cutting speeds from 25 to 60 ft. per min. and return speeds as high as 160 ft. per min. can be obtained. Cutting speeds below 25 ft. can be obtained if necessary.

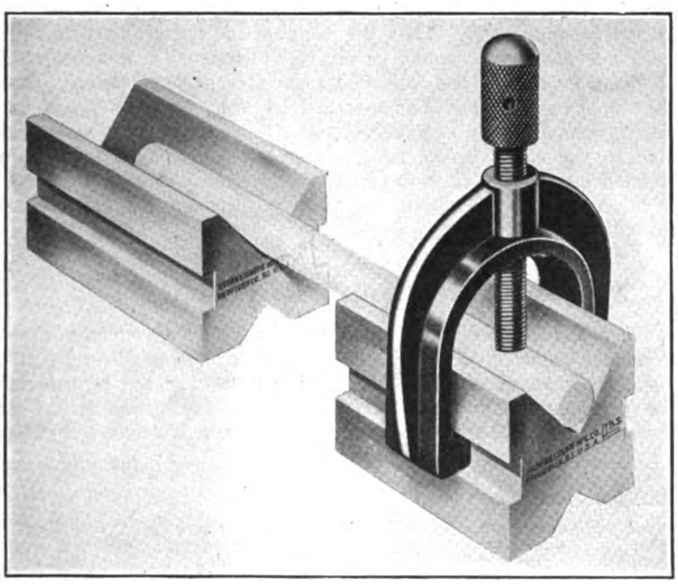
Failure of line voltage is liable to occur at any time from various causes. If the line voltage fails, the generator will continue to run for a short time because of its momentum, but since the control is effected through the generator field circuit, the planer will be reversed as usual until the whole system gradually comes to rest. Stops at each end of the table prevent accidents caused by the operator failing to fasten the reversing dogs.

The equipment includes a safety pendent switch suspended from a swivel on the arch or crosstie of the planer by a flexible cable which enables the operator to keep the switch close at hand when working. The entire control of the table motion, starting, stopping, reversing or jogging by very small fractions of an inch, is obtained by the single knob on this switch without requiring the operation of any other devices. The machine when running may be stopped instantly by pushing the knob upward.

This equipment has been placed on the market by the Niles-Bement-Pond Company, New York.

A pair of useful V-blocks and clamp

The pair of V-blocks and clamp shown in the illustration are particularly useful for holding circular pieces to be drilled, milled or ground. They hold the piece



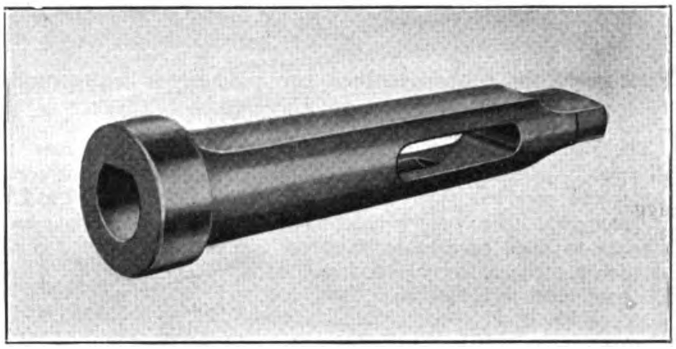
Method of using V-blocks and clamp

firmly and prevent it from turning or slipping while the work is being done.

The blocks are made of cast iron and are intended for general machinist's use. They are carefully finished and the grooves on the sides of the blocks are accurate. Each block is 2 in. long by $1\frac{1}{2}$ in. square and will hold work up to $1\frac{1}{2}$ in. in diameter. They are made by the Brown & Sharpe Manufacturing Company, Providence, R. I.

Improved sleeve for holding drills and reamers

When drilling or reaming holes it is often necessary to use two or more sleeves when the tool used has a small shank. When the Lovejoy Tool Works, Chicago, redesigned its original drill sleeve they had this point in mind. The new sleeve is flattened on the

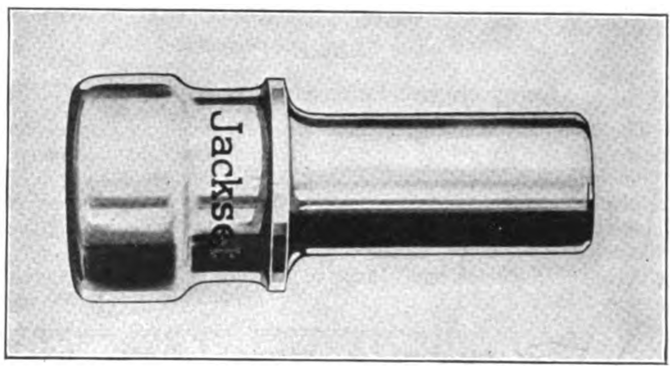


Drill sleeve designed for nesting

outside so that the sleeves can be nested. It also has a strong re-enforcement at the lower end of the sleeve which is claimed to make it much stronger than the original design. The inside and outside dimensions are practically the same as the standard Morse drill sleeve.

Triple service alloy steel rivet sets

The life of a rivet set is determined by the number of rivets it will drive before it breaks. The Ingersoll-Rand Company, New York, has recently placed on the market a rivet set for pneumatic hammers which is said to



Ingersoll-Rand alloy steel rivet set

have shown a great increase in rivets driven per set over other types previously manufactured by this company. It is made of alloy steel which will stand a great degree of heat from hot rivets without the temper becoming drawn. It is specially forged and then heat treated by a new process.

General News

Damage estimated at $500,000 was caused by a fire at the shops of the Canadian National at Bridgewater, Nova Scotia, recently. Most of the buildings, together with eight locomotives, a number of freight cars and a large quantity of stores were destroyed. The buildings consumed included the roundhouse, machine shop, car shop, boiler shop, master mechanic's office and some smaller buildings. Some damage, too, was done to the station on the opposite side of the tracks. Seven of the eight locomotives destroyed were serviceable, and the eighth was undergoing repairs.

Pennsylvania places orders for passenger equipment to cost $6,000,000

The Pennsylvania has placed orders for 357 passenger cars of all steel construction, to be delivered as soon as equipment companies can complete their construction. The orders call for 222 baggage cars, 105 passenger coaches, 15 combination passenger and baggage cars, 10 combination baggage and mail cars and 5 combination passenger, baggage and mail cars. The estimated cost of this equipment is $6,000,000.

Locomotive inspection, first six months of 1925

During the first six months of 1925, 40,321 locomotives were inspected by the Bureau of Locomotive Inspection of the Interstate Commerce Commission, of which 18,151 were found defective and 1,910 were ordered out of service, according to the Commission's monthly report to the President on the condition of railroad equipment. During June 7,381 locomotives were inspected, of which 3,044 were found defective and 292 were ordered out of service. The Bureau of Safety during the same month inspected 95,215 freight cars, of which 2,709 were found defective, and 2,011 fuel oil showed an increase. The average cost of fuel for road locomotives in freight and passenger train service (charged to operating expenses) for Class I steam railways in April was $2.79 a ton, as compared with $3.19 last April and $2.81 for four months of this year. There was also a reduction in the number of tons used, and the total cost for the month was $20,532,551. The average cost of fuel oil was 3.29 cents per gallon, as compared with 2.80 cents last April and 3.11 cents for four months. The total passenger cars, of which 23 were found defective. During the month 16 cases, involving 32 violations of the safety appliance acts, were transmitted to various United States attorneys for prosecution.

Long engine runs on the Southern

The Southern Railway is now running passenger locomotives long distances on a half dozen of its main lines, as follows:

Between Washington and Atlanta, 637 miles, two engines instead of four, changes being made at Spencer, N. C., the changes formerly made at Monroe, Va., and Greenville, S. C., having been eliminated.

Between Cincinnati and Jacksonville, 840 miles, three engines are used instead of six, changes being made only at Chattanooga and Macon. Formerly engines were also changed at Somerset, Atlanta and Valdosta.

Between Cincinnati and New Orleans, 836 miles, three engines are used instead of five, changes being made only at Chattanooga and Meridian. Engines are also being run through without change between Bristol, Va., and Chattanooga, Tenn., 242 miles; Chattanooga and Memphis, 314 miles; Atlanta, Ga., and Columbus, Miss., 290 miles; Louisville, Ky., and St. Louis, Mo., 274 miles; and Rome, Ga., and Meridian, Miss., 300 miles.

I. C. C. requested to provide an accounting system which will show true car repair costs

On July 14 a communication was addressed to the members of the Interstate Commerce Commission by seventeen representative members of the freight car repair industry, criticising the decision of the Commission relative to the contracting of equipment repairs by the railroads which it rendered on the basis of an investigation instituted early in 1921. It was claimed that the report of the inquiry made in 1921 did not present all of the essential information pertaining to car repair contracts, and that full hearings had not been conducted, although the report inferred that such had been the case. Furthermore, the system of accounting used by the railroads, which was approved by the Commission, did not show the actual car repair costs as overhead costs were not included.

The representatives of the freight car industry presented twelve factors which they considered to be sufficiently important to merit consideration by the Commission, some of which are as follows:

That the main business of railroad companies is transportation, which is a special occupation requiring special training, and is, in its fundamentals, as foreign to manufacturing as the latter is foreign to transportation. Railroad shops have no spur of competition but have a substantial monopoly of a railroad's work. Railroad accounts cannot show, and do not show, proper manufacturing costs, and are not a useful factor in controlling manufacturing costs, for if existing railroad accounts had contained proper and informative manufacturing data, it would not have been necessary for the Commission to make a special study of the cost for the investigation in 1921. That the Commission's decision that railroad overhead costs could be entirely disregarded was contrary to common reason and scientific principles of accounting. That the duplication of facilities afforded by both a railroad and car repair industry is an economic waste. That no conclusion applicable to the car industry as a whole can be justly drawn from isolated instances. That no proper comparison can be made unless it takes into consideration the relative speed of the delivery of the work performed.

Wage statistics for April

Class I railroads reported to the Interstate Commerce Commission a total of 1,745,643 employees as of the middle of April, 1925, an increase of 23,368, or 1.4 per cent over the returns for the previous month. The maintenance of way group shows an increase of 40,710 employees, but this increase is offset somewhat

Freight Cars Installed and Retired

Month 1925	Installed during month	Aggregate capacity tons	Retired during month	Aggregate capacity tons	Owned at end of month	Aggregate capacity tons	Building in R. R. shops
January	11,768	551,263	7,867	326,812	2,341,109	103,812,974	5,285
February	15,024	721,867	9,453	365,111	2,346,687	104,169,525	4,878
March	16,007	753,947	12,067	474,644	2,350,697	104,454,128	5,572
April	13,749	652,462	10,497	423,322	2,353,956	104,683,798	8,072
May	12,982	612,607	8,658	335,401	2,356,641	104,902,235	9,042
Total for 5 months	69,530	....	.....	....	....	....	.....

Figures as to installations and retirements prepared by Car Service Division A. R. A. Figures cover only those roads reporting to the Car Service Division. They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

by decreases in the maintenance of equipment and transportation groups. Notwithstanding the net increase in the number of employees, the total compensation, $234,808,094, shows a decrease of $3,368,830, or 1.4 per cent, which resulted principally from a decrease in the number of hours worked per employee.

Compared with the returns for the same month last year, the employment in April, 1925, shows a decrease of 2.3 per cent and the total compensation a decrease of 0.9 per cent. The average straight time earnings per hour for all employees reported on an hourly basis increased from 57.4 cents per hour in April, 1924, to 58.2 cents in April, 1925.

Foreign railway news

Motive power and rolling stock on the Italian State Railways during 1924 was improved by the addition of 40 steam and 147 electric locomotives, six passenger cars, one baggage car, and 417 freight vehicles for the standard gage lines. During the year, 116 steam locomotives were withdrawn from service, and 707 passenger cars, 202 baggage and mail cars, and 4,463 freight cars were retired.

Sixty locomotives and 20 tenders for the Czechoslovak Railways will be purchased shortly, according to an announcement by the Ministry of Railways. The Ministry of Finance has been requested to provide the necessary funds, and the appropriation is expected to be made available this month. It is understood, however, that only Czechoslovak manufacturers will be invited to submit bids.

The Polish government will order for its railways rolling stock to cost $7,000,000, including 4 locomotives, 3,000 freight cars and 100 passenger cars and $4,200,000 worth of rails, switches and signal apparatus. The railways will also spend $7,200,000 on improvements to car shops, for which considerable new material will be purchased.

The liberal investment of the German railways in new equipment during the inflation period is now being reflected in abnormally low orders for locomotives and other rolling stock by the railway board established under the Dawes plan, according to Commercial Attaché Herring, at Berlin. According to most observers the German railways at the end of 1923 were in excellent condition, apart from the abnormal deterioration under the Franco-Belgian Régie during the Ruhr occupation. There is, therefore, considerable uneasiness now in German rolling-stock plants because of the tendency of the railway administration to limit new orders drastically. Only 80 locomotives are to be ordered during the current year, and there will be a corresponding reduction in contracts for spare parts and other equipment, except material for track building. The situation is not as serious as it might be, however, because such large companies as the Allgemeine Elektricitaets-Gesellschaft and the Borsig and Krupp works, which manufacture a large variety of products, are able to divert some of the labor employed in rolling-stock shops to other branches of their plants and otherwise adapt themselves to the situation. The fact remains, however, that even with reduced production, pressure on export markets will be greater, and there will doubtless be a more pronounced tendency to underbid American and foreign manufacturers—dumping German stock at sacrifice prices and compensating by price increases in lines where the domestic or foreign market, or both, is better able to absorb German goods.

Woman invents sleeping car of unique design

Mrs. Agnes R. Rossman, Scotch Plains, N. J., has recently designed and received patents on a sleeping car which is a real innovation in sleeping car architecture. The lower berths are so designed to insure perfect privacy. The berth, when made up, is enclosed by rolling steel curtains which are locked on the inside by the occupant. A private dressing room with a toilet and wash basin, is provided for each lower berth. They are arranged two rooms together with a connecting door. The dressing room doors leading to the aisle are provided with a shoe bin with a glass in it so that the porter can see whether or not they contain shoes. The porter can open the bin from the outside by a master key. These doors also contain an exhaust blower fan which is controlled by a two-stay switch. The fans can be used for blowing the air from the dressing room and lower berth or for drawing fresh air into these rooms. This arrangement maintains perfect ventilation. Each car is provided with two shower baths, one with each private dressing room of the berths at each end of the car. The lower berths are so designed that if the passenger is tall, the berth can be extended six or eight inches, thus providing ample space for the occupant.

The upper berths are easily accessible by means of a permanent folding stairway which the occupant can place in position without calling a porter. Along the edge of each upper berth runs a safety rail which protects the passenger from falling out. These berths have tight fitting sliding curtains independent of the lower berth which may be fastened on the inside, insuring privacy. The upper berths are provided with a luggage closet over the private dressing rooms of the lower berths, accessible through two doors, one opening into the upper berth and the other to the aisle. This closet provides ample space for luggage, facilities for hanging up clothing as well as trays, racks, etc., for toilet articles, a rack for a thermos bottle, a mirror for dressing and space for shoes.

In the day time this car has practically the same appearance as the present day Pullman. The occupants of the private berths have the advantage of seeing out both sides of the car, which is not obtainable in a compartment car.

Meetings and Conventions

Tool Foremen's Association to meet in Chicago

The American Railway Tool Foremen's Association will hold its thirteenth annual convention at Hotel Sherman, Chicago, on September 2, 3 and 4. H. T. Bentley, general superintendent of motive power of the Chicago & North Western, will deliver the opening address. G. T. Martin, assistant to general superintendent of motive power of the Chicago, Milwaukee & St. Paul, will speak on "The Tool Foreman's Responsibilities," and E. L. Woodward, western mechanical editor of the Railway Age, will present a paper on "The Importance of the Tool Room." Committee reports will deal with the following subjects: Standardization of tools in the locomotive and car shops; grinding in the railroad shops; jigs and devices for the locomotive and car shops; forging machine dies; machine tool equipment for the tool room, and economies possible by standardized small tools. An exhibit of machine and hand tools in connection with the convention will be displayed by the Supply Association of the American Railway Tool Foremen's Association.

New York Railroad Club outing

The New York Railroad Club held its second annual outing, or mid-summer festival, at the New York Athletic Club, Travers Island, and at the Winged Foot Golf Club, Mamaroneck, N. Y., on Thursday, July 9. Over 200 golfers went to the golf club early in the morning. A special train left New York for Travers Island at noon. The Long Island Railroad Band played en route and headed the procession in the march from the station at Pelham Manor to Travers Island. A buffet luncheon and dinner were served at the clubhouse and the party returned to New York on a special train late in the evening.

Among the various forms of relaxation which were a part of the outing were a number of competitive sports in which prizes were awarded. These included a golf tournament at the Winged Foot Golf Club and a tennis tournament and track meet at Travers Island in the afternoon. A variety of prizes was offered in the golf tournament covering low gross, low net, "kicker's" handicap, and others, the winners of prizes being as follows: D. D. Cooke, American Locomotive Company; C. E. Bryant, Johns-Manville, Inc.; G. H. Weiller, American Locomotive Company; H. M. Behre, Surety Engineering Company; L. O. Smith, Columbia Machinery Works; C. G. Melvin, Galena Signal Oil Company; W. J. Fripp, general manager, New York Central; C. C. Hubbell, purchasing agent, Delaware, Lackawanna & Western; C. L. Bardo, formerly general manager, New York, New Haven & Hartford; Frank Hedley, president, Interborough Rapid Transit, and A. N. Dugan, Bronze Metal Company.

The results of the track meet were as follows: 100-yd. dash won by E. Dunbar, Pennsylvania System, 10⅗ sec.; 220-yd. dash won by S. Marion, Erie Railroad, 24⅖ sec.; first 440-yd. race won by H. Higgins, Safety Car Heating & Lighting Company, 54 sec.; second 440-yd. race won by J. F. Mitchell, Interborough

Rapid Transit, 54 sec.; 880-yd. run won by G. C. Gault, Safety Car Heating & Lighting Company, 2 min. 5⅗ sec.; one-mile relay race for company teams won by the Safety Car Heating & Lighting Company, 3 min. 30 sec., with the Erie, second, and the Interborough team, third.

In the tennis tournament, the singles were won by R. P. Spooner, American Abrasive Metals Company, with Harry Doyle, runner-up. The doubles tournament was won by Harry Doyle and C. C. Willetts. Other special features were a soft ball baseball game between the railroad men and the railway supply representatives, swimming and quoits. Scott Donahue was chairman of the General Committee. J. S. Doyle, superintendent of equipment, Interborough Rapid Transit Company, was director of sports and entertainment.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting September 15, 16 and 17, 1925, at St. Paul Hotel, St. Paul, Minn.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention September 2-4, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division. A. F. Steubing, Bradford Corp., 25 West Forty-third Street, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention week of September 14, 1925, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 27 to 30, inclusive, Hotel Sherman, Chicago.

CANADIAN RAILWAY CLUB.—C. R Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth street, Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt Street, New York, N. Y. Regular meetings second Thursday each month, Hotel Statler, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Annual convention Hotel Sherman, Chicago, September 22-24.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month except July, August and September, at Hotel Cleveland, Public Square, Cleveland.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention, Hotel Winton, Cleveland, Ohio, August 18, 19 and 20.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 1809 Capitol Ave., Omaha, Neb.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Annual convention September 8-11, Hotel Sherman, Chicago.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday each month, except June, July and August at 29 West Thirty-ninth Street, New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal Regular meetings second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in each month, except June, July and August.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern Railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth Street, Cleveland, Ohio. Annual meeting September 15-18, 1925, Chicago.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 189 West Madison Street, Chicago. Regular meetings third Monday in each month, except June, July and August.

Supply Trade Notes

Thomas J. Hyman, secretary and treasurer of the Illinois Steel Company, Chicago, died on July 5.

Charles T. Westlake, chief mechanical engineer of the Commonwealth Steel Company, St. Louis, Mo., died on July 22.

L. J. Ferderber has been appointed assistant to the first vice-president of the General American Tank Car Corporation, Chicago.

S. H. Worrell has been appointed district sales manager of the Detroit Seamless Steel Tube Company, with headquarters at Detroit, Mich.

T. V. Buckwalter, chief engineer of the Timken Roller Bearing Company, Canton, Ohio, has been elected vice-president in charge of engineering.

The Ajax Manufacturing Co. has removed the Cleveland, Ohio, office to its new plant on Chardon road near Euclid avenue, Euclid, Ohio, a suburb of Cleveland.

Carl A. Methfessel, manager of sales of the eastern district of the Duff Manufacturing Company, New York, died on July 22 at his home in Ridgefield Park, N. J.

Edward Payson Bigelow, sales agent for the American Steel Foundries Company, New York, died on July 20 at his home in New York from apoplexy, at the age of 81.

H. E. Passmore, formerly salesman of the Grip Nut Company at Columbus, Ohio, has been appointed sales manager of the Davis Brake Beam Company, Pittsburgh, Pa.

The National Forge Company, Louisville, Ky., has appointed E. H. & R. W. Benners as its representative in New York, for the sale of its knuckle pins and "S" and "Z" irons.

E. P. Blanchard, advertising manager of the Bullard Machine Tool Company, Bridgeport, Conn., has been appointed also assistant sales manager, with headquarters at Bridgeport.

Herbert G. Cook has been appointed Pacific Coast representative of the Railway Steel-Spring Company, New York. Mr. Cook's headquarters are at 582 Market street, Hobart building, San Francisco, Cal.

L. W. Grout, vice-president and sales manager of the Keating Valve Company, Springfield, Mass., for the past three years, has joined the sales organization of the Bridgeport Brass Company, Bridgeport, Conn.

H. E. Passmore has been appointed sales manager of the Davis Brake Beam Company, with headquarters at 1602 Oliver building, Pittsburgh, Pa. Mr. Passmore was formerly in the employ of the Grip Nut Company.

The E. L. Essley Machinery Company, Chicago, has been appointed exclusive agent for the Buffalo Forge Company, Buffalo, N. Y., to sell punches, shears, bar cutters, slitting shears and beam shears in Chicago territory.

The Ypsilanti Foundry Company, Ypsilanti, Mich., manufacturers of piston rings, has awarded a contract for a new machine shop to the Austin Company, Chicago. The building will be a two-story structure, 50 ft. by 100 ft.

Otis B. Duncan, 53 West Jackson boulevard, Chicago, has been appointed representative for the Chicago territory of the Johnston Manufacturing Company, Minneapolis, Minn., manufacturers of industrial oil-burning equipment.

The Johnston Manufacturing Company, Minneapolis, Minn., manufacturers of industrial oil-burning equipment, has appointed Otis B. Duncan, 53 West Jackson boulevard, Chicago, as representative for the Chicago territory.

C. W. Moore, 1523 Candler building, Atlanta, Ga., is representing the Goddard & Goddard Company in the southeastern territory covering North Carolina, South Carolina, Georgia, Florida, Alabama and Tennessee west to the Tennessee river.

Walter T. Comley has been elected vice-president in charge of service and production, and Adam P. Arnold, secretary and treas-

urer of the Franklin Railway Supply Company, Ltd., of Montreal, Canada. Leland Brooks, vice-president and treasurer, has resigned.

A sales and service branch office has recently been opened by the DeVilbiss Manufacturing Company, Toledo, Ohio, at 4614 Woodward avenue, Detroit, Mich., where a display and stock ot the complete DeVilbiss spray-painting equipment will be carried at all times.

The American Manganese Steel Company has opened a new plant at Los Angeles, Cal., which gives the company facilities for producing about 25,000 tons of manganese steel castings annually. The new plant will begin production at the rate of 100 tons a month.

J. C. Dawes, formerly with the Weldcraft Company, Pittsburgh, Pa., has been appointed a sales representative at the Pittsburgh branch of the International Oxygen Company, Newark, N. J. L. W. McCullough has been appointed sales representative for the branch at Toledo.

C. W. Marshall has been appointed eastern sales manager of the Sunbeam Electric Manufacturing Company, Evansville, Ind. Mr. Marshall will have his office in the Grand Central Terminal, New York. He was formerly Chicago district manager of the American Arch Company, New York.

The Union Tank Car Company has awarded a general contract to the Hughes-Foulkrod Company, Pittsburgh, Pa., for a car construction, repair and conditioning plant at Whiting, Ind., including a foundry, machine shop, power plant, wheel shop, and other structures; to cost approximately $1,700,000.

R. L. M. Taylor has been appointed district sales representative of the New York State and Eastern Pennsylvania territory, known as the Reading district of the Reading Iron Company, Reading, Pa. Mr. Taylor joined the Reading Iron Company one year ago, after serving for five years with the A. M. Byers Company.

The Dempsey Furnace Company, Jersey City, N. J., has been consolidated with the W. N. Best Corporation, 11 Broadway, New York City. The combined furnace business of the two companies will in future be operated as the Dempsey furnace division of the W. N. Best Corporation under the personal direction of H. B. Dempsey.

Charles E. Miller has been appointed representative in the Chicago district of the Premier Staybolt Company, Pittsburgh, Pa., succeeding L. W. Widmeier, resigned. The Chicago office of the company is now located at 548 Railway Exchange building. C. S. Carter has been appointed northwestern representative, with office at 752 McKnight building, Minneapolis, Minn.

B. A. Tozzer, manager of the Cleveland office of the Niles-Bement-Pond Company, New York, has been appointed sales manager of the New York office. A. E. R. Turner, in charge of the office at Walkerville, Can., succeeds Mr. Tozzer at Cleveland. Sydney Buckley, chief engineer at Philadelphia, Pa., has been appointed works manager of the crane works at Philadelphia, to succeed V. O. Strobel, resigned.

Raymond B. Hosken, assistant to the vice-president in charge of sales of the Sullivan Machinery Company, Chicago, has been promoted to general sales manager. He entered the employ of the Sullivan Machinery Company in the local sales department in Chicago after graduating from the University of Michigan in 1910. In 1914 he was promoted to Australasian manager, with headquarters in Sydney, N. S. W., and in 1921 he was promoted to assistant to the vice-president in charge of sales at Chicago, which position he held until his recent promotion.

Henry S. Mann, for many years district manager in charge of the Chicago office and shops of the Metal & Thermit Corporation, has resigned to become district sales manager of the Standard Stoker Company, Inc., New York. Mr. Mann will have his headquarters in the McCormick building, Chicago. Previous to entering the service of the Metal & Thermit Corporation he had been connected with a number of railways, serving as a locomotive engineer with the Boston & Maine, the Northern Pacific, the Atchison, Topeka & Santa Fe and the Wabash. He has served as a director of the National Railway Appliance Association of Chicago; vice-president of the American Welding Society and vice-president of the International Railroad Master Blacksmiths' Supplymen's Association.

W. D. Horton, western railway representative of the Murphy Varnish Company at Chicago, has been appointed manager western railway sales, with headquarters at 50 West Twenty-second street, Chicago. From 1908 to 1914 he was associated with the Railway Age as traveling subscription representative and on April 1, 1914, was appointed circulation manager, which position he held until March 1, 1919, when he resigned to go as district railway sales manager to the Patton Paint Company. On December 1, 1919, he resigned to become associated with the Murphy Varnish Company as western railway representative, which position he held until his recent promotion. Mr. Horton has had a wide selling experience, having spent several years previous to 1908 selling various commodities, such as stationary engines, boilers, woodworking and other machinery. In this work he traveled extensively in North America, the West Indies and in Central and South America.

John F. Schurch, vice-president of Manning, Maxwell & Moore, Inc., has been elected president to succeed John M. Davis, who has resigned to become president of the Delaware, Lackawanna & Western. Mr. Schurch graduated from the University of Minnesota in 1893. The same year he entered the service of the Minneapolis, St. Paul & Sault Ste. Marie, where he served consecutively in the office of the auditor, the general superintendent and in the transportation department, resigning in 1905 after having attained the position of chief clerk to the vice-president. He was then associated with the Railway Materials Company of Chicago until February, 1914, when he was elected vice-president of the Damascus Brake Beam Company, with office in Cleveland, Ohio. The following June he was elected president of the same company, which position he resigned later in the same year and was elected vice-president in executive charge under President T. H. Symington, of the T. H. Symington Company. In June, 1922, Mr. Schurch left the Symington Company to become a vice-president of Manning, Maxwell & Moore, Inc., in charge of sales in the middle west and the west, with headquarters in Chicago. Mr. Schurch served in 1922 as president of the Railway Supply Manufacturers' Association, which had in charge the exhibits at Atlantic City in connection with the meetings in June of Division V—Mechanical, and Division VI—Purchases and Stores, A. R. A.

J. F. Schurch

Master blacksmiths to visit machine tool exposition

An invitation to attend the second exposition of forging machines and bolt and nut machinery which is being held at the plant of the National Machinery Company at Tiffin, Ohio, August 21 to 26, inclusive, has been extended to the International Railroad Master Blacksmiths' Association, which is holding its annual convention in Cleveland, Ohio, August 18, 19 and 20. The first day of the exposition, Friday, August 21, has been set aside as master blacksmiths' day. A large part of the work to be demonstrated will be of special interest to members of the Blacksmiths' Association, and special arrangements have been made for the transportation by special train of the members and their families between Cleveland and Tiffin.

This exposition is the second of its kind to be conducted by the National Machinery Company. The first was held 15 years ago. It is planned to have a total of 62 machines, many of which are of new design, tooled up and in operation. The exhibit will contain a complete line of the National Machinery Company's forging machines, each of which will be in actual operation on various kinds of forging work. There will also be a complete nut and bolt plant in operation, in which will be shown a number of designs which have recently been developed.

Trade Publications

PULLEY GRINDERS.—Circular F descriptive of a new pulley grinder designed for finishing the face of belt surface of metal pulleys from the rough after chucking the holes, has been issued by the Graham Manufacturing Company, Providence, Rhode Island.

THE DRILL FOR TODAY.—In a 16-page pamphlet the Detroit Twist Drill Company, Detroit, Mich., presents an account of the conditions leading to the development of the rolled type of twist drill. It is an interesting story containing much information of value to the user of drills.

WHAT RUST CAN DO.—The Detroit Graphite Company has issued a folder showing various types of structures exposed to the elements and emphasizing the deterioration that occurs unless they are properly protected, setting forth the merits of its Degraco paint for this purpose.

GRINDING AND POLISHING MACHINES.—The Builders Iron Foundry, Providence, R. I., and its associate, the Diamond Machine Company, have issued a catalogue descriptive of a new line of belt and motor-driven ball bearing grinders and polishing machines and swing frame grinders.

LEDRITE ROD-O-GRAPH.—The second edition of the Ledrite Rod-o-graph, which provides in chart form a convenient way to figure the weight of brass rod required to make 1,000 screw machine parts to known dimensions, has been issued by the Bridgeport Brass Company, Bridgeport, Conn.

DODGE SHOP FACILITIES.—The engineering, foundry and machine shop facilities available for the manufacture of its special machinery and equipment are visualized in a book recently issued by the Dodge Manufacturing Corporation, Mishawaka, Ind. A wide range of special equipment is also shown.

WHEEL TRUING BRAKE SHOES.—A 12-page, illustrated brochure descriptive of the wheel truing brake shoe designed to remedy flat wheels, grooved tires, long flanges and deformities to which wheels are subject in both steam and electric service, has been issued by the Wheel Truing Brake Shoe Company, Detroit, Mich.

AIR COMPRESSORS.—The latest types of Tilghman air compressors and vacuum pumps are described and illustrated in Catalogue No. C25 which has recently been issued by the Tilghman's Patent Sand Blast Company, Ltd., Broadheath, Manchester, England. Air compressing plant design is also briefly described in this catalogue.

VISES.—A 56-page illustrated price list descriptive of the particular features of Prentiss vises, has been issued by the Prentiss Vise Company, New York. The new collar fastening for screws, designed to fasten the screw to the front jaw and then draw it out when the screw is turned to open the vise, is also illustrated and described.

GRINDING WHEEL STANDS.—The characteristic features of the Norton motor driven grinding wheel stands and specifications are given in a 20-page brochure which has been issued by the Norton Company, Worcester, Mass. The Norton combination protection and dust hoods, cylinder chucks and grinding wheel dressers are also briefly described.

REAL PRODUCTION TOOLS.—Under this title a series of illustrated booklets is being issued by the Goddard & Goddard Company, Detroit, Mich., describing the various types of special milling cutters and metal cutting saws manufactured by that company. A brief description of the types is supplemented by information as to the proper application to different classes of work.

ROTARY SHEARS.—Catalogue No. 80 describing in a comprehensive manner the various sizes and types of, and the different attachments provided for Quickwork shears and indicating how the machines operate and how the material is handled into them, has been issued by the Quickwork Company, St. Marys, Ohio. The catalogue is 9 in. by 11 in. and is attractively bound in leather, with gold lettering.

RECLAIMING SCRAP CAR AXLES.—The reclaiming of scrap car axles as practiced by a middle western railroad shop is described in an eight-page illustrated circular recently issued by the Ajax Manufacturing Company, Euclid, Ohio. The railroad referred to makes it a practice to centralize at one point and reclaim every scrap axle available from the entire system, the needs of the road with practically all except the largest size axles being supplied from this source.

STOKERS.—A two-page illustration showing the application of the Du Pont Simplex Type B stoker to a locomotive is contained in Bulletin No. 101, which has been issued by the Standard Stoker Company, New York. The stoker, which weighs approximately 5,800 lb., is simple in application, and the only stoker parts located on the backhead of the locomotive are the small distributing valves which may be located under the fire door opening, or any other place convenient to the fireman.

TRACTORS.—The operation and control of Elwell-Parker tractors, in general, is described in the first section of a 40-page illustrated catalogue, No. 140, which has been issued by the Elwell-Parker Electric Company, Cleveland, Ohio. Separate sections are then devoted to the special features and specifications for each of the haulage units, which include all electric motor-driven, rubber-tired industrial trucks, tractors, portable cranes or special types receiving their power from storage batteries carried on them.

PUSH BUTTON OPERATED OIL SWITCH.—Bulletin No. 1048, descriptive of a new push button operated oil switch for starting squirrel cage motors and also single phase motors, has been issued by the Electric Controller & Manufacturing Company, Cleveland, Ohio. This starting switch throws the motor across the line when the "start" button is released. It is arranged for no-voltage protection or no-voltage release, as desired, and provides overload and phase failure protection by means of expansion wire temperature relays.

AUXILIARY LOCOMOTIVE.—Catalogue H, descriptive of the operation, advantages, principal details and performance of the Bethlehem auxiliary locomotive, which is a tractor truck used as the rear truck of the locomotive tender, has been issued by the Bethlehem Steel Company, Bethlehem, Pa. This unit carries an auxiliary steam engine actuated by steam from the locomotive and controlled from the cab. Its function is to add more tractive force for starting, accelerating and operating at low speeds on heavy grades.

DIESEL ENGINE BUILDING.—Bulletin No. 1040, entitled "Modern methods in Diesel engine building," has recently been issued by Fairbanks, Morse & Co., Chicago, Ill. An attempt is made in this attractive 32-page bulletin to picture the present-day engineering refinements that enter into the construction of Diesel engines and what these refinements mean to the purchaser, each step in the process of manufacture of an engine, from the selection of the raw material to the final inspection and application of the finished product, being described.

HIGH SPEED TOOLS.—The Cleveland Twist Drill Company, Cleveland, Ohio, has issued its Catalogue No. 41 in a smaller and more comprehensive form. The catalogue contains 244 pages, so arranged as to make it a quick and ready index to the various high speed tools listed, which include drills, reamers, extractors, mills, counterbores, etc., and a few special tools. Several new tools, including special drills for Bakelite and slate, a small jobbers carbon drill set, a spiral fluted shank taper and several types of reamers, have been included in the catalogue.

CHEMICAL ENGINEERS.—Railroad men, both prospective and long-time users of Dearborn chemical service, will find much of interest in an attractively prepared booklet, "A House of Chemical Engineers," recently issued by the Dearborn Chemical Company, Chicago. For many years this company has been prescribing and blending the chemicals required to correct scaling, foaming, pitting, and corroding conditions in the boilers of locomotives and power plants operated by the railroads and other industries, thus conserving fuel and rendering more permanent the investments in power plant machinery. The booklet referred to contains 39 5½-in. by 8-in. pages and presents in attractive form a pictorial record of the Dearborn plant, its laboratories, storage tanks, manufacturing department and organization. Pictures of the officers of the company, beginning with Robert F. Carr, president, are included.

Personal Mention

General

E. Von Bergen has been appointed general air brake, lubricating and steam heat engineer of the Illinois Central, with headquarters at Chicago.

John R. Jackson has been appointed engineer of tests of the Missouri Pacific, with headquarters at St. Louis, Mo., a newly created position.

E. A. Kuhn has been appointed engineer of motive power of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio, a newly created position.

F. J. Herter has been appointed engineer of rolling stock of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio. This is a newly created position.

A. J. Pichetto has been appointed air brake, lubricating and steam heat inspector of the Northern and Western lines of the Illinois Central, with headquarters at Chicago.

George B. Hart has been appointed assistant to the general superintendent of motive power of the Southern Pacific, with headquarters at San Francisco, a newly created position.

G. M. Wilson, superintendent, motive power shops, of the Canadian National, with headquarters at Montreal, Que., has been transferred to Stratford, Ont., succeeding John Roberts.

T. W. Kennedy has been appointed air brake, lubricating and steam heat inspector of the Southern lines of the Illinois Central and the Yazoo & Mississippi Valley, with headquarters at Memphis, Tenn.

W. B. Embury, master mechanic of the Armourdale shops of the Chicago, Rock Island & Pacific at Kansas City, Kans., has been appointed superintendent of motive power, with headquarters at El Reno, Okla.

A. McDonald has been appointed superintendent, motive power shops, of the Canadian National, with headquarters at Montreal, Que., succeeding G. M. Wilson. Mr. McDonald is 37 years of age. He was born at Stratford, Ont., and entered the service of the Grand Trunk in Stratford when he was 16. He was apprenticed to both the machinst and fitter trades, spending 7 years in acquiring both. On completion of his apprenticeship he served in those capacities until he was given a minor foremanship a few years later. In 1917 he was promoted to assistant superintendent of the shops at Point St. Charles. In 1919 he was appointed acting superintendent of motive power, Eastern lines, returning a short time later to his post as assistant superintendent at Point St. Charles, in which capacity he was serving at the time of his recent promotion.

J. F. Jennings, whose promotion to superintendent of motive power of the Michigan Central, with headquarters at Detroit, Mich., was reported in the May issue of the *Railway Mechanical Engineer*, was born on June 11, 1871, at Jackson, Mich. He entered railway service in September, 1891, as a locomotive fireman on the Lake Shore & Michigan Southern, now a part of the New York Central, and was later employed in a similar capacity on the Michigan Central. He was promoted to traveling fireman in February, 1903, and in January, 1904, was promoted to assistant traveling engineer. Mr. Jennings was promoted to road foreman of engines in May, 1905, and held that position until May, 1913, when he was promoted to assistant division master mechanic. He was promoted to division master mechanic at Bay City, Mich., in February, 1915, and held that position until October, 1919, when he was promoted to assistant superintendent of motive power. Mr. Jennings continued in that capacity until his recent promotion to superintendent of motive power.

Frank H. Becherer, who has been appointed assistant to the mechanical superintendent of the Boston & Maine, with headquartres at Boston, was born on August 23, 1882, in New York City. He graduated from high school in Indiana in 1901, and attended a Y. M. C. A. night school in Buffalo until 1906. He entered railway service in 1901, as a billing clerk on the Erie, and held this position until 1903, when he became assistant chief clerk of the car department. In 1904, he was promoted to piece work supervisor of the car department and, in 1905, to chief clerk of the department. On June 1, 1907, he resigned and went with the Pennsylvania as assistant chief M. C. B. billing clerk, and was successively until 1918, freight car repairer, freight car inspector, air brake inspector, piece work inspector of freight, traveling inspector for the superintendent of motive power, assistant foreman car inspector (freight), assistant foreman passenger cars, foreman passenger cars and foreman enginehouse, powerhouse and machine shop. On March 25, 1918, he resigned to enter the service of the Interstate Commerce Commission, Bureau of Valuation, as a junior inspector of car equipment. On October 1, 1919, he became senior mechanical engineer engaged in valuing freight, passenger, work, powerhouse and machine shop equipment and locomotives. On March 1, 1922, he resigned and entered the service of the Boston & Maine as assistant engineer, corporate engineer's office. On October 1, 1922, he became mechanical inspector, and in April, 1923, general inspector car maintenance, which position he held until June 16, 1925, when he was appointed assistant to the mechanical superintendent.

Master Mechanics and Road Foremen

W. A. King has been appointed road foreman of engines of the Seaboard Air Line, with headquarters at Wildwood, Fla.

A. Hambleton has been appointed master mechanic of the El Paso-Amarillo division of the Chicago, Rock Island & Pacific, succeeding J. C. Cole.

R. R. Harris has been appointed road foreman of engines of the Tampa & Gulf Coast and the Tampa Northern, with headquarters at Tampa, Fla.

G. A. Haslett has been appointed general road foreman of engines, Southern district, of the Seaboard Air Line, with headquarters at Tampa, Fla.

F. B. Kester, master mechanic of the Chicago & North Western at Escanaba, Mich., has been appointed master mechanic, with headquarters at Antigo, Wis.

J. S. Jones, assistant master mechanic of the Chicago & North Western at Antigo, Wis., has been appointed master mechanic, with headquarters at Escanaba, Mich.

H. M. Agin has been appointed road foreman of engines of the Florida division of the Seaboard Air Line, with headquarters at Tampa, Fla., succeeding G. A. Haslett.

E. H. Carlson has been appointed assistant master mechanic of the Fargo division of the Northern Pacific, with headquarters at Staples, Minn., succeeding J. A. Marshall.

J. C. Trigg has been appointed assistant road foreman of engines of the Florida division of the Seaboard Air Line, with headquarters at Waldo, Fla., succeeding H. M. Agin.

J. A. Marshall, assistant master mechanic of the Fargo division of the Northern Pacific at Staples, Minn., has been promoted to master mechanic of the Pasco division, with headquarters at Pasco, Wash.

J. C. Cole, master mechanic of the El Paso-Amarillo division of the Chicago, Rock Island & Pacific, with headquarters at Dalhart, Tex., has been transferred to Chickasha, Okla., succeeding A. R. Ruiter.

A. R. Ruiter, master mechanic of the Chicago, Rock Island & Pacific, with headquarters at Chickasha, Okla., has been transferred to the Kansas City Terminal-St. Louis division, succeeding W. B. Embury.

H. J. McCracken, formerly district boiler inspector of the Northern district of the Southern Pacific at Sacramento, Cal., has been promoted to assistant master mechanic of the Western division, with headquarters at West Oakland, Cal.

W. B. Embury, master mechanic of the Kansas City Terminal-St. Louis division of the Chicago, Rock Island & Pacific, with headquarters at Armourdale, Kans., has been promoted to superintendent motive power of the Second district, with headquarters at El Reno, Okla.

Car Department

W. T. Westall has been appointed assistant district master car builder (Fourth district) of the New York Central, with headquarters at Air Line Junction (Campbell street shops), Toledo, Ohio.

E. B. Dailey has been promoted to engineer of car construction of the Southern Pacific, with headquarters at San Francisco, Cal. Mr. Dailey was born on February 1, 1870, in Omaha, Neb., and was educated at Creighton College, Omaha, Neb. He entered railway service in July, 1886, as a machinst apprentice on the Union Pacific at Omaha, and was later employed as a machinist on the Northern Pacific, the Oregon Railway & Navigation Company, the Union Pacific and the Southern Pacific. In September, 1892, he was employed as a draftsman on the Union Pacific at Omaha, later being promoted to inspector of equipment. He was promoted to chief draftsman in 1903 and was later promoted to assistant mechanical engineer. In February, 1913, Mr. Dailey was appointed assistant to the director of purchases of the Southern Pacific at New York. On June 1, 1918, he was appointed first assistant manager of the Procurement section of the United States Railroad Administration at Washington, D. C. In September of the same year he returned to the Southern Pacific as corporate mechanical engineer of the lines in Texas and Louisiana. From March 1, 1920, to January 1, 1921, he was assigned to special work, on the latter date being again appointed assistant to the director of purchases of the Southern Pacific at New York. He held that position until his recent promotion to engineer of car construction.

E. B. Daily

Purchasing and Stores

A. G. Follette, supervisor of the stores catalog of the Pennsylvania, has been appointed assistant chief general material supervisor with headquarters at Philadelphia, Pa.

D. C. Curtis has been promoted to chief purchasing officer of the Chicago, Milwaukee & St. Paul, with headquarters at Chicago. Mr. Curtis was born in 1878 at Remington, Ind., and entered railway service in 1898 as an office boy in the engineering department of the Chicago, Burlington & Quincy at Chicago. He was transferred to the mechanical department in 1899 and in 1904 was placed in charge of the piece work department. In 1907 Mr. Curtis was transferred to the stores department and was promoted to inspector of stores in 1909. He was promoted to traveling storekeeper in 1914 and held that position until 1919, when he was appointed supervisor of stores of the Northwestern region under the United States Railroad Administration. He was appointed general storekeeper, lines east, of the Chicago, Milwaukee & St. Paul, with headquarters at Milwaukee, Wis., in 1920. and held that position until his promotion to chief purchasing officer.

D. C. Curtis

W. B. Hall, whose promotion to general purchasing agent of the Denver & Rio Grande Western, with headquarters at Denver, Colo., was reported in the May issue of the *Railway Mechanical Engineer,* was born on March 7, 1877, at Salt Lake City, Utah. He entered railway service in 1891 as an office boy in the motive power and car department of the Rio Grande Western, now a part of the Denver & Rio Grande Western. He was later promoted to clerk, which position he held until 1895, when he was promoted to stationer. Mr. Hall was appointed a clerk in the stores department in 1899 and in the following year was promoted to chief clerk to the purchasing agent. He was appointed stationer of the Denver & Rio Grande, with headquarters at Denver, Colo., in 1903, and in 1905 was promoted to division storekeeper, with headquarters at Salt Lake City, Utah. Mr. Hall was promoted to general storekeeper in July, 1908, and held that position until his recent promotion to general purchasing agent.

W. B. Hall

N. M. Rice, general purchasing agent of the New York, New Haven & Hartford, at New Haven, Conn., has been elected vice-president in charge of purchases and stores, with the same headquarters. Mr. Rice was born on December 28, 1863, at Rome City, Ind., and was educated in the public schools of that city. He entered railway service in May, 1887, as a brakeman on the Gulf, Colorado & Santa Fe, and from this time until April 1, 1901, he held several positions in the transportation and stores department. From April, 1901, to April, 1903, he was assistant general storekeeper of the Atchison, Topeka & Santa Fe Coast Lines, at which time he became general storekeeper of the same road in charge of material, fuel and stationery. He held this position until November 13, 1913, when he was appointed general purchasing officer of the St. Louis & San Francisco, with headquarters at St. Louis, Mo. From 1915 to 1916, he was third vice-president in charge of purchases, and from 1916 to 1919, was second vice-president of the same road. From 1919 to 1920, he was vice-president of the Pierce Oil Corporation, and, in 1920, became general purchasing agent of the New York, New Haven & Hartford, and also of the Central New England and New England Steamship Company.

N. M. Rice

Shop and Enginehouse

J. D. Bumcrots, lead machinist in the back shop of the Kansas City Southern at Pittsburg, Kans., has been appointed to the newly created position of shop efficiency supervisor.

John Roberts, superintendent, motive power shops, Canadian National, at Montreal, Que., has been appointed general supervisor of shop methods, with headquarters at Montreal, a newly created position.

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Next month's issue will contain abstracts of the proceedings of the conventions held by the following associations: Traveling Engineers', International Railway General Foremen's, Chief Interchange Car Inspectors' and Car Foremen's, and American Railway Tool Foremen's

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Railway Mechanical Engineer

Vol. 99 September, 1925 No. 9

Using the Railway Mechanical Engineer

Just how can the best use be made of the *Railway Mechanical Engineer?* Each number is brimful of constructive suggestions and facts which are of vital interest to mechanical department officers and foremen. We have had a number of requests in recent months for suggestions as to the subjects to be discussed at staff meetings or before foremen's clubs. After the August issue of the *Railway Mechanical Engineer* was mailed we wrote to the author of the letter on page 495 which is signed "Output." Here is an extract from his reply. "As you probably know, one of ———'s methods of keeping his foremen from senile decay is to mark an article in some mechanical magazine and request a paper as to its merits to be read at one of the foremen's meetings. That is the way 'Output' came to life." We find that a growing number of master mechanics, shop superintendents and general foremen are adopting the practice of referring to different articles in the paper and asking those associates whose departments the articles concern, to express an opinion as to the value of the articles and their application to their peculiar conditions. Indeed, there are superintendents of motive power who regularly ask some of their subordinates for opinions on articles which are published in the technical papers or on addresses or reports that are made before railroad clubs or technical associations or societies. There is much to commend this practice. It stimulates and inspires officers and foremen to crystallize their thinking and to search out and adopt the very best methods and practices. Where the reports or findings are presented at a meeting of the foremen or local officers, the resulting discussion is quite likely to develop features and improvements which were not mentioned in the original articles or suggested by the man reporting upon it. There is always great value in open and full and free discussion on matters of this kind. We hope that more and more of the mechanical officers will use the *Railway Mechanical Engineer* in this way.

The foreman's responsibility

The third prize article in the *Railway Mechanical Engineer* competition on the foreman and his responsibilities appears elsewhere in this number. It was written by J. W. Murphy, general foreman of the Boston & Albany at West Springfield, Mass. Mr. Murphy approaches the question in a very different way from "Bill Brown" in the first prize article, which was published in our June number and which seems to have started a real controversy; nor is the treatment similar to that of the second prize article by John Linn of the Santa Fe, which was printed in our August number.

Mr. Murphy's article challenges attention from several viewpoints. We often hear it said that a cause or an organization cannot stand still; it must go forward or backward. To what extent is it true that foremen, when once appointed to that position, settle down to routine work and fail to make an effort to keep abreast of the times and to improve themselves by study and observation in order to give a larger service to their employers, as well as the men under them, and to fit themselves for larger responsibilities? If they do stand still they will go backward, for the entire conception of relations in industry and transportation has been changing and is steadily rising to higher ideals. Mr. Murphy indicates that a foreman should "make himself more fit each day to render that service in the most effective way." The inference is that the foreman, whether newly appointed or old on the job, should constantly study and strive to make his efforts more effective; otherwise he will stagnate and fail in his duty to his employer, the employees and the public. Is this conception too idealistic? In a way it agrees closely with the underlying spirit of the other two prize winning articles by "Bill Brown" and Mr. Linn. Practical results are what we are after in this materialistic age. Can they be secured by foremen who are dominated by a spirit of service to their fellows?

Purpose of shop schedules

When scheduling systems for repair work were first introduced in railway shops, they were looked on with a great deal of skepticism by the supervisory forces. They were considered the brain child of some efficiency expert who did not know the true conditions of the shops. But, after a great deal of explaining and persuasion, these same sceptics began to realize that those responsible for the introduction of shop schedules did know the true condition of the shops and were trying to bring order out of chaos. In order to increase production, reduce repair costs and still maintain quality of workmanship, a system must be devised whereby every department, every supervisor and every workman must know what to do, when to do it, and how to do it, so that the system may properly function. One of the problems facing the mechanical officers today is to lessen the large amount of unessential detail work with which the average shop foreman has to contend. It is obvious that attention to details which can better be handled automatically by system is not the function of the foreman and besides it is absolutely impossible for one man to know intimately all the details of the work carried on in a large railroad shop. By making each workman or group of workmen in each craft responsible for the completion of a certain job at a predetermined time, the supervisory officers are relieved of a mass of details enabling them to give their attention to the more important problems of personnel and organization. A

scheduling system which functions properly, will quickly indicate what departments need strengthening. The schedule boards indicate infallibly where delays periodically or persistently occur. Friction between departments is almost entirely eliminated as it is not possible to unload on one department causes for delay which belong to another. Thus, it can be said that scheduling eliminates one of the human frailties of "passing the buck to the other fellow"—as the constant reappearance of the daily delay report stimulates foremen and workmen to establish a record of performance on merit alone instead of concealing their deficiencies at the expense of their fellow workmen.

Locomotive efficiency improves

At the World's Fair held in St. Louis in 1904, several types of locomotives were given exhaustive tests in a newly designed test plant constructed as a part of the Pennsylvania Railroad exhibit. The official report of these tests was published in 1905, exactly 20 years ago, and an interesting and highly illuminating indication of the advance in locomotive design and construction since that time can be obtained by comparing the figures then obtained with locomotive test plant results secured in 1925.

One of the locomotives tested at St. Louis in 1904 was a heavy Consolidation type designed for freight service and considered thoroughly modern at that time. For purposes of comparison, the Missouri Pacific three-cylinder Mikado type locomotive, which was tested at the Altoona test plant during the past year, may be selected. The Consolidation weighed 173,000 lb. on the drivers and developed a maximum drawbar pull of 22,078 lb., as opposed to 244,500 lb. weight on the drivers and 61,847 lb. drawbar pull for the Mikado. In other words, while the weight on the drivers of the modern locomotive has increased 41 per cent, the drawbar pull available for hauling freight trains has increased 180 per cent or nearly trebled.

The effect of improved modern locomotive design on the coal pile is strikingly manifested by the relative figures for coal consumption. The 1905 Consolidation consumed from 2.9 to 5.4 lb. of dry coal per indicated horsepower hour dependent upon the load conditions, as against 2.1 to 3.8 lb. for the 1925 three-cylinder Mikado. It will therefore be observed that the coal consumption per unit of power developed is decreased almost one-third in the modern locomotive.

The real significance of what locomotive designers have accomplished, however, is shown in a comparison of the figures for efficiency. The maximum boiler, machine and overall efficiencies of the Consolidation were 78.9, 84.8 and 5.1 per cent respectively, the corresponding efficiencies for the three-cylinder Mikado being 83, 92 and 7.3 per cent. The designer's work in getting increased utilization of the heat in the coal is indicated by this increase of 4.1 per cent in boiler efficiency. In spite of the increased size, weight and complication of the modern locomotive with consequent increased frictional losses and lubrication difficulties, the machine efficiency has been increased 7.2 per cent. The increase of 2.2 per cent in overall efficiency while small numerically means a saving of many thousands of tons of coal annually.

The statement is made that many mechanical department officers deprecate the ultimate economy of fuel-saving accessories on locomotives and do not favor the application of these devices because they add to the cost of maintenance and increase the possibility of failures on the road. That any considerable number of mechanical department officers hold this view may well be doubted, for ample evidence is available that the practice of many railroads in applying these devices has paid big returns on the investment. With present fuel and labor costs, it pays to utilize the most efficient locomotives available.

The opinion of one enginehouse foreman regarding the improved performance of modern locomotives is indicated in the following unsolicited comment: "If the modern locomotive were as wasteful of coal as its predecessor of 20 years ago we would have to hook a coal car on behind the tender to carry the extra fuel." This statement is an exaggeration which, however, shows the real opinion of a railroad mechanical officer who sees the effect of improved locomotive design including fuel-saving devices on the coal pile. The question may well be asked, "How many of those old 1905 locomotives are still in operation?" With the modern locomotive consuming one-third less coal per horsepower hour developed than is being burned by locomotives of earlier and relatively inferior types, it is plain that the latter should be retired as fast as possible or rebuilt and thoroughly improved.

Foremanship training

The chamber of commerce at Milwaukee, known as the Milwaukee Association of Commerce, has for several years conducted a Foremen's Safety School under the direction of the Safety Division of the Association. The success of the school, the work of which is outlined in a communication on another page of this issue from Harry J. Bell, manager of the Safety Division, is undoubtedly due in a large measure to the broad and comprehensive way in which this whole problem of safety has been approached. Indeed, the people in Milwaukee in referring to the work of the school characterize it as "wholesaling safety." The theory on which it is based seems to be that real progress can be made not by treating a disease, but by getting at the fundamental causes and eliminating it entirely. The purpose therefore seems to be not to go into a lot of details as to the prevention of accidents, but rather to improve the leadership ability of the foremen, in order that they may help and inspire the men to a larger and more intelligent interest in their work. This is reflected in better morale and greater efficiency. It means also that the foremen must understand thoroughly the fundamental principles affecting production, employment, labor turnover, leadership, etc. It is understood that a number of railroad foremen have taken this course or are enrolled in it. It would be interesting to know just what benefits they have received in the direction of improving their leadership ability.

Are there not many other industrial communities in which large railroad shops are located where the Milwaukee method could be reproduced to advantage by getting the local chamber of commerce or other civic bodies interested? The industries and the railroads have a common problem to solve. The principles underlying successful foremanship are the same in both fields and getting the foremen together to discuss these principles, where it is possible, might bring about a closer and more cordial relationship between the railroads and the industries in the particular community.

There is also another public source from which some of the railroad groups can undoubtedly receive help in foremanship training. Reference was made in the survey on foremanship training in the June number of the *Railway Mechanical Engineer* to the study course which is being followed by the foremen of the Lehigh Valley at Sayre, Pa., which was furnished by the Engineering Extension Department of State College, Pennsylvania. Some of our friends in the Grand Trunk Western shops at Battle Creek, Mich., have advised us that a representative of the Department of Industrial Education of the

University of Michigan conducted a most effective course in foremanship training in Battle Creek last year. Undoubtedly a goodly number of the other state universities are prepared to give assistance in this direction. Indeed, an open forum discussion on foremanship training at the Railroad Y. M. C. A. Summer School at Blue Ridge, N. C., last month developed the fact that two Railroad Y. M. C. A. secretaries are negotiating with representatives of state universities to help them put on such a course this next season for the foremen and supervisory officers in their particular localities. One of these Y. M. C. A. secretaries is located in New Hampshire and the other one in Georgia. The Industrial Department of the Y. M. C. A. has also promoted courses on foremanship and many of the larger Y. M. C. A's throughout the country include such courses in their educational program.

It is evident that a number of railroads are going to tackle this problem seriously during the next season; there are several ways in which to approach this task, depending upon local conditions and available facilities. The above suggestions cover only a few of the possible approaches.

New Books

LAYING OUT FOR BOILER MAKERS: *Fourth edition, revised. 8½ in. by 12 in., 385 pages, 550 illustrations. Published by the Simmons Boardman Publishing Company, New York. Price $8.00.*

The fourth edition of this book, which has been well known for many years in the field of boiler making, has been completely revised and amplified. New chapters have been added on the layout of return tubular boilers and on the locomotive boiler. These chapters were specially prepared by authorities on the subject and are the last word in modern layout practice. The principles of triangulation and projection are discussed in the opening chapter of the book and applied to practically every form of layout work that is required in a modern shop. A chapter is devoted to marine boiler construction with the practice of one of the largest shipyards in the country taken as a basis. A chapter is devoted to layout problems, including uptakes, Y problems, stacks, tanks, breeching, tapering sections, chutes, buoys, transition pieces, pipe layouts, elbows, hoppers, hoods, ventilators and numerous other miscellaneous problems. The book has been divided into fourteen chapters and these have been completely cross-indexed for ready reference to any problem that might come up in the course of work in nearly any plate or boiler shop.

THE RESISTANCE OF EXPRESS TRAINS, *by C. F. Dendy Marshall, M. A. Bound in cloth, 9 in. by 12 in., 86 pages, 55 illustrations and diagrams. Published by the Railway Engineer, London, Eng. Price 20 shillings.*

The subject of train resistance is extremely interesting and of practical importance to railroad men. Although considerable experimental work has been performed relative to this problem comparatively little that has been written about it has been published in book form. The author, in writing this book has sought to provide a book from which the important results of numerous tests and experiments may be obtained.

The book contains 17 chapters including such subjects as internal resistances of cars, track resistance, effect of acceleration, gradients, curves and winds. There are five chapters devoted to the discussion of wind resistance in which the effect of oblique winds, direct winds and resultant winds are considered. Three additional chapters are also included in which the author has reviewed the recent developments and findings on train resistance, a summary of formulas, and a description of the dynamometer car used on the Great Western Railway of England.

The author has made a number of suggestions relative to new lines of experiments which can be followed without much difficulty. He has also described a number of modifications applicable to standard practice that are aimed to bring about better running conditions and economy in the use of fuel. Although the book is written primarily from the standpoint of railway practice in Great Britain, practically all of the conditions described and the treatment of the various problems of train resistance are applicable to railway practice in this country.

What Our Readers Think

Who can answer this question?

OMAHA, Neb.

TO THE EDITOR:

We have recently had several inquiries relative to the following question: "How does fire affect steel underframes of box cars that have had the woodwork burned off?"

I have been trying to procure information relative to this from several railroad men, but they have not had any experience that would warrant their giving me any authentic information. As the *Railway Mechanical Engineer* is in a position to gather the latest that is to be obtained in railroad practice, I am appealing to you. Can you help me?

F. W. BASON.
Manager, Railway Educational Bureau.

Reclaiming asbestos locomotive lagging

MINNEAPOLIS, Minn.

TO THE EDITOR:

I am a reader of your magazine and have found many valuable and interesting articles for locomotive and car men of a practical nature. I notice also that a good many questions are answered by the readers as well as the editorial staff, and this leads me to ask for a practical method of reclaiming asbestos locomotive lagging. My principal trouble seems to be in applying sufficient pressure in moulding the new blocks, and I would appreciate any suggestions along the lines of a practical home made press.

THEO. NYGREN,
Locomotive carpenter foreman, Soo Line.

Treated water and firebox renewals

DECATUR, Ill.

TO THE EDITOR:

I have just read with interest the editorial in the August *Railway Mechanical Engineer* relative to the service given by a firebox on a Pacific type locomotive on the Southern Pacific, the firebox having lasted somewhat over 12 years and the unusual length of service being attributed to hot water washing of boilers and treatment of feedwater.

I think there are few that realize the possibility of increasing firebox life through hot water washout plants and particularly through the use of treated water. Below are statistics in regard to firebox life on some of the

larger Wabash class of power and which may be of interest to the readers of the *Railway Mechanical Engineer*.

Our firebox renewals are very light and we attribute this almost entirely to the fact that all locomotive boiler water used on the railroad is treated, with the exception of the few waters that contain a little natural sodium carbonate or soda ash. Our method is to treat the water at the roadside supply tank with enough soda ash to neutralize any sulphate hardness in the water and provide a slight excess of soda ash. The treatment was started in 1912 and extended gradually until it was completed in 1916.

In 1912 we purchased 16 Pacific type passenger locomotives with 24-in. by 26-in. cylinders, total weight of engine and tender 423,840 lb. Only six of these have received fireboxes and three of them were applied before treated water was used on the divisions on which they were running. In the same year 63 Mikado locomotives were purchased with 26-in. by 30 in. cylinders, weight of engine and tender 423,840 lb. Of these 63 engines, some of which were run for several years without treated water, only eight have received fireboxes, and these eight were applied in 1915 when they were converted from saturated steam engines to superheated engines, it being thought advisable when we first started converting the engines to apply complete fireboxs. This practice was soon stopped and no fireboxes have since been applied to this class of locomotive.

Thirty heavy six-wheel switch engines were purchased in 1906 and 1907 and 12 similar engines in 1912. Six of the first 30 have received fireboxes but none of those purchased in 1912.

In 1917 twenty-five Santa Fe type locomotives with 29-in. by 32-in. cylinders, weight of engine and tender 592,000 lb., were placed in service, and none of these have received fireboxes or even part side sheets. These Santa Fe type locomotives have 96-in. by 120 in. fireboxes and 60-in. combustion chambers.

The very large increase in firebox life is only one of the advantages that can be obtained by water treatment, but in order to obtain the full advantage of the treatment for locomotives over any certain operating district all water that is used by them must be treated by some method that will result in the water in the boiler always showing an excess alkalinity.

W. A. POWNALL,
Mechanical Engineer, Wabash Railway.

Foremen's safety school

MILWAUKEE, Wis.

TO THE EDITOR:

The Milwaukee Association of Commerce organized, in 1920, the first full-time, budget-supported safety division in chamber of commerce history. During nearly five years of intensive operation the activities of this division have expanded to embrace practically every large employer of labor in Milwaukee and its environs; it is, furthermore, having a noteworthy effect upon industrial conditions throughout Wisconsin. Certain of its projects have attained the proportion of national institutions. An instance in kind is its Foremen's Safety School.

Proceeding on the unquestionably sound premise that 85 per cent of *industrial accidents are preventable by education*, and cognizant of the important position occupied by foremen in the modern industrial structure, this school was conceived as a means of "wholesaling" safety to the entire industrial community. It is now in its fifth season and has an enrollment of 4,538—principally foremen and forewomen. Attendance at its meetings averages 3,000!

The school each year holds six monthly gatherings and is divided into sectional meetings and general sessions, all held in the evening in the Milwaukee Auditorium, a building which is particularly suited to this purpose. Sectional meetings, in session from 7:45 to 8:30, are devoted to addresses and practical discussion of the specific, semi-technical subjects in hand, while the general sessions, from 8:45 to 9:30, are given over to speeches of universal appeal and inspirational in character. During the fifteen minute intermission between the sectional and general meetings, an industrial band provides entertainment. Exhibits, demonstrations, stereopticon and moving pictures all contribute to the success of the plan.

The school is sectionalized by industrial grouping as follows: Machine shop, sheet metal, packers and tanners, woodworking, building construction, foundry, electrical and all-trades, the latter being arranged to provide for those industries not specifically included in the special trade sections. These sections meet in eight separate halls during the forepart of the evening and join in the general meeting for the remainder of the evening. Each person enrolled is given an attendance card which is perforated to indicate presence at meetings, a master record of enrollment and attendance being maintained at the headquarters office.

Thus, with the very minimum of effort and expense, the school provides an opportunity for employers to take advantage of a constructive educational plan of tremendous value to executives and supervisors in general *and foremen in particular. For the school deals, in an altogether practical manner, with such important aspects of industrial betterment as accident prevention, production, employment, labor turnover, fire prevention and leadership.* How important it is that serious, earnest effort be directed to these problems is illustrated by the fact that Wisconsin in 1923 had 20,941 compensation cases, costing $3,719,030 and that its fire loss that year was $11,500,000!

The concluding meeting of the school takes the form of a graduation banquet at which certificates are awarded to those who meet the requirements laid down by the committees in charge of this operation, composed of 54 representatives of our leading industries. The graduates of the school now number over 4,000 and it is expected 2,000 more will graduate from the present school.

This project, like the sundry other operations of the Safety Division, is designed to develop a sense of responsibility on the part of the foremen for the safety and well-being of those who work under his direction; to inculcate in his mind a high regard for the principles and practices of safety and to make him understand that safety increases efficiency, improves morale, decreases material spoilage and aids production. That accidents are not a necessary by-product of industry and, consequently, it becomes the duty of the foreman not only to practice safety himself, but to teach it by example and precept to those with whom he has contact.

The dynamic force behind the work of the Safety Division is Frank Frey, Jr., of Geuder, Paeschke & Frey Co., manufacturers. Mr. Frey, as Chairman of the Division, is a member of the board of directors of the Association of Commerce. The Association is in affiliation with the Chamber of Commerce of the United States, the National Safety Council and the National Fire Protection Association. The extent of co-operation necessary as a means of obtaining results in its various operations, is evidenced by the fact that 71 speakers from various sections of the United States will address the sundry meetings functioned under the Division's 1924-1925 program of activities.

HARRY J. BELL,
Manager, Safety Division, Milwaukee Association of Commerce.

The foreman and his responsibility

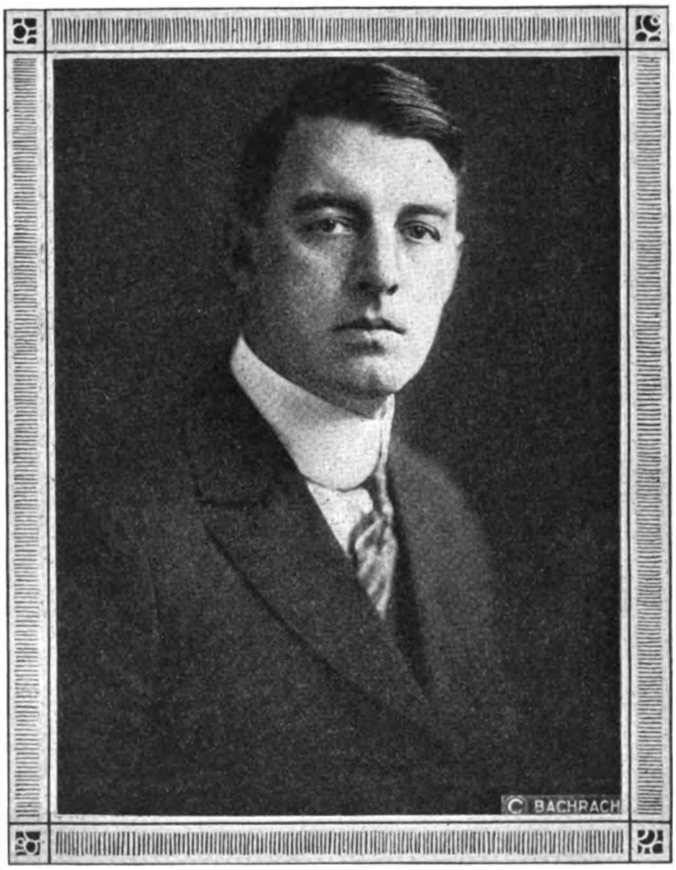
Third prize article in the competition recently held by the Railway Mechanical Engineer

By J. W. Murphy

General foreman, Boston & Albany, West Springfield, Mass.

THE foreman in any industrial organization is a connecting link between the management and the worker, and upon the character of this link depends not only the success of the whole organization, but of the foreman himself. Essentially the foreman's job is to direct his men in such a way as to obtain the greatest possible production, quality considered. The manner in which he accomplishes this object, however, has a tremendous bearing upon the soundness of the entire organization, and the cordial relations between the management and the employees.

The foreman is confronted daily with problems of a technical nature and of human relations. The first he can solve if he is thoroughly conversant with his trade, and the second if he is a real man with his heart in the right place. No man should ever consider accepting a foreman's job unless he is willing to assume the responsibility that goes with it. The national game of "passing the buck" which was so prevalent among railroad men is being eliminated, for men are coming more and more to the realization that a great deal of material and spiritual satisfaction is gained—that bigger things are in store—if the game of life is played honestly.



J. W. Murphy

Must have an ideal

A successful foreman must have an ideal and strive in the daily routine to attain that ideal; otherwise he will be a failure. There is no such thing as luck; if we look into the lives of great men we will find that all of them had an ideal in life and worked hard to realize it. That is why they were successful in whatever walk of life they moved.

The question then arises, what should be the railroad shop foreman's ideal and what should he do to attain it. His ideal should be that of service; service to his management, the public, to his workers, and to himself. His position is big, bigger and more important than that of some of his executives, for he has a broader field to serve and a great deal more is required of him. Because of this he should be fit to handle the job and make himself more fit each day to render that service in the most efficient manner.

Much has been said and written about applying the "Golden Rule," but the "Golden Rule" alone will not solve all problems; neither will it make good foremen. In my opinion there are three outstanding features which make the successful foreman and these are:

1. Certain characteristics of leadership.
2. A thorough knowledge of his trade and keeping abreast with new developments in his line.
3. Honesty to the management, to the employees, and to himself.

Must be a leader

The first of these requirements is obvious. In order to direct his men to efficient production he must be a leader, either born or developed by proper training. This is especially desirable in a railroad shop where, due to the nature of the work, systematizing is more difficult than in an industrial plant; hence more responsibility devolves on the foreman. A foreman who possesses the quality of leadership is able to organize and place his men so as to obtain maximum production with the facilities at his disposal. In many of our railroad shops today too little attention is paid by the foreman to physique, psychology, or natural aptitude of the workers. If a foreman does not give sufficient serious consideration to these characteristics of the worker, he is soon confronted with the problem of "lost motion" in his department and oftentimes he cannot locate the cause. If he would only study his men he would soon find that they work most efficiently when placed on jobs for which they have a natural aptitude. In everyday routine the average foreman does not pay much attention to these things, but the successful foreman does. A foreman who is a leader with an ideal will imbue his ideal and enthusiasm in his workers and thus develop a dependable man and an efficient organization.

A man, to be a successful foreman, must have a thorough knowledge of his trade. This is essential in order to perform his duties properly and hold the respect of his men. The type of man which is needed in our railroad shops today as foreman is one who will give a direct answer to any question pertaining to the technical side of

his work, for there is nothing which will cause a worker to lose respect for his foreman more than stalling when the answer should be forthcoming quickly. A foreman should take a broad view of his position; be open-minded in regard to new improvements and methods. The successful foreman is never the self-satisfied, know-it-all type of man. He is the man who, realizing his deficiency of knowledge on certain subjects, will study them. He is the man who will keep himself informed on new developments in the mechanical end of railroading by means of books and periodicals dealing with these subjects. By doing this he is making himself more valuable to the company, to his workers, and to himself.

Human relations

The question of human relations in a railroad shop is one of vital importance to the organization and there is no official who can do more to further good-will than the foreman. When all industry was in its infancy, it was not uncommon for the owner or manager to mingle with the workers where each could exchange his point of view and promote good relations. Today in our complex industrial organization, this is impossible and it devolves upon the foreman to familiarize himself with the policy of the management and convey this to the worker. It is up to the foreman to dispel all rumors or misunderstandings in regard to the management; it is up to him to respect and speak well of his superiors, for in this way his men will develop a respect for the offiicals and for the foreman himself. The management knows that the application of the "Golden Rule" is for the good of all concerned, but the foreman is the man who must, and the only man who can, put it across in a practical way.

What is there in a railroad shop to keep a man content and interested? He has a certain fixed rate of pay which he cannot exceed, so there is no incentive in that direction. He may become a foreman, but he has no illusions in that respect, for one in a hundred may be promoted and the opportunity does not come very often. Why doesn't he stagnate? The thing that keeps him moving is the dynamic force of good relations between his management, his foreman, and his fellow workers. The successful foreman realizes this and puts all his efforts to promote the good relations, and wherever possible to improve working conditions and make life in the shop as pleasant as possible. The successful foreman is a real man with a soul and a heart in the right place, who never forgets that his men are human and have hearts and souls. He is not the man who peddles gossip or petty little reports to his superiors, but looks on his job in a big way; in an honest and manly way.

What is the foreman going to gain by putting his best efforts into the daily grind when just "getting by" is so easy; when shirking certain responsibilities relieves him of so much strain; when "passing the buck" is so pleasant a game. The foreman's gain is twofold. First, he has the moral satisfaction that he is playing the game right; and second, when the opportunity for promotion comes it is always the man who has been doing his duty honestly every day who gets the promotion, for after all, real achievement is an accumulation of hard, earnest every-day work.

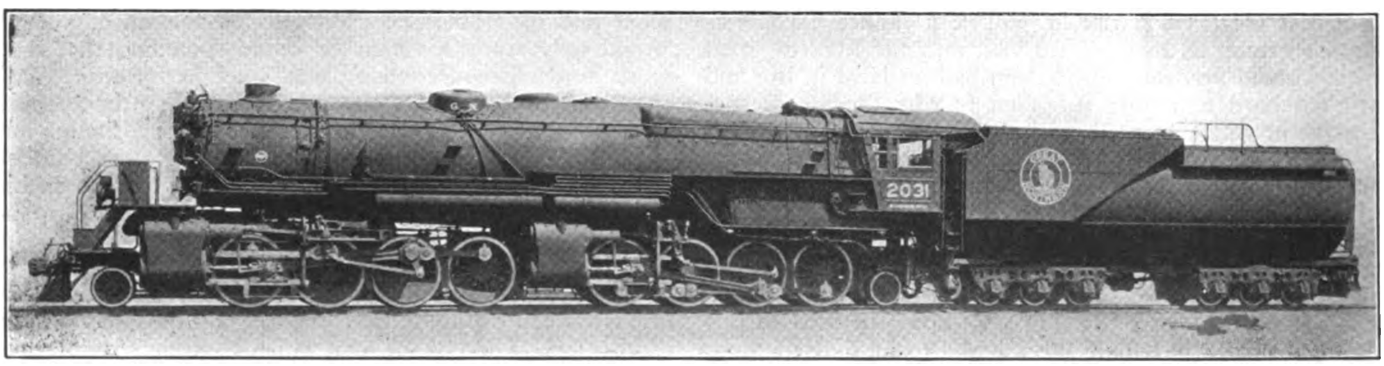
We must not forget, however, that the individual foreman alone cannot build the whole organization; that there must be co-operation from the president down; that there must be co-operation among the foremen, that the petty little jealousies among them must cease, for in the final analysis nothing is gained by them.

Which is going to succeed, stagnation or progress? I'll leave it to the foremen to solve the riddle.

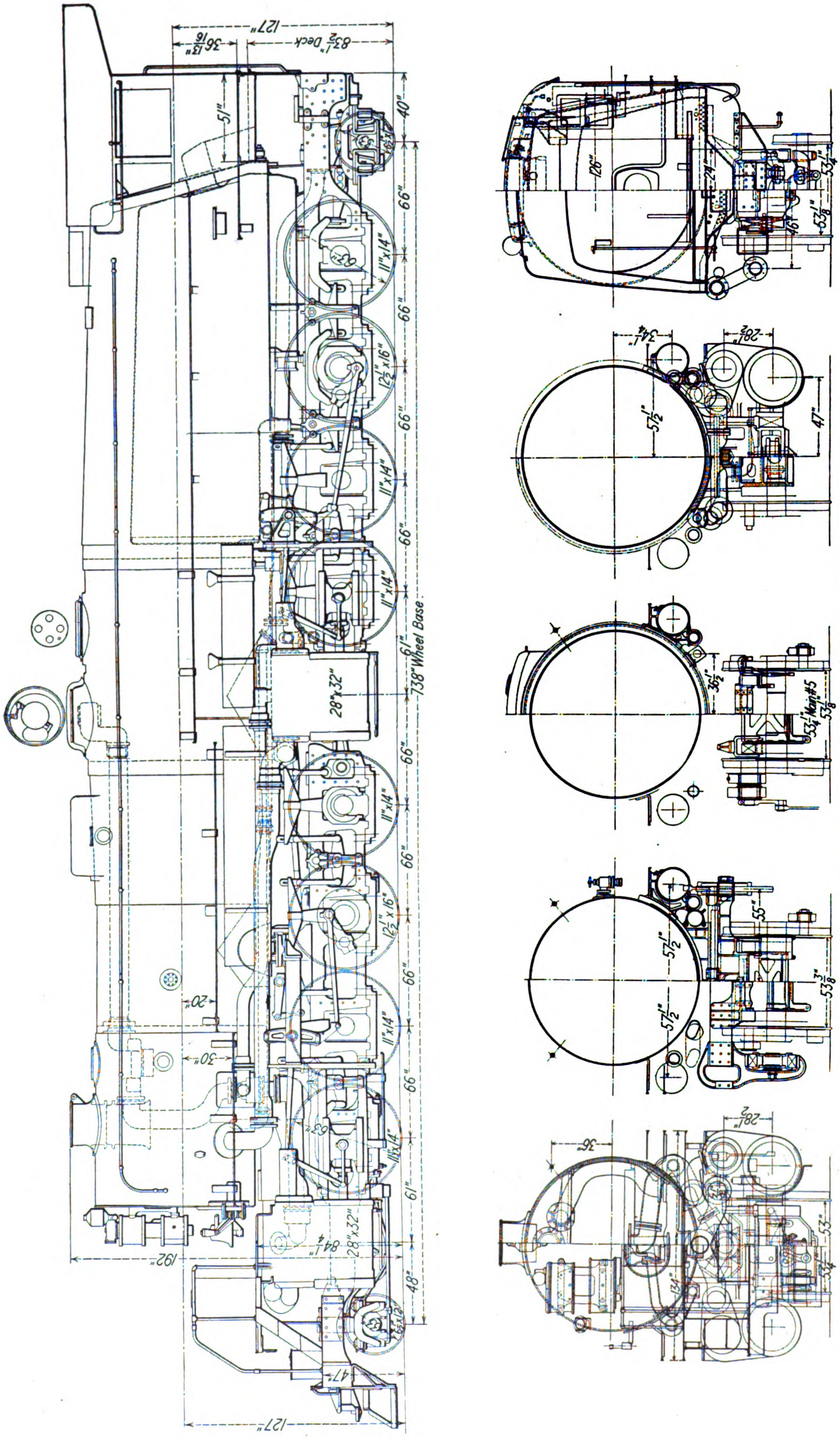
Mallet locomotives acquired by Great Northern

The Baldwin Locomotive Works, Philadelphia, Pa., recently delivered to the Great Northern four articulated locomotives of the 2-8-8-2 type. These locomotives, designated by the Great Northern as Class R-1-S, are intended for operation between Cut Bank and Whitefish, Montana, a distance of 128 miles, where the line crosses the continental divide. The ruling grade approaching the summit west-bound is one per cent, while east-bound it is 0.8 per cent with a pusher grade of 1.8 per cent, 13.8 miles long. The elevation at the summit is 5,211 ft. The sharpest curves on this section of the line are of 10 deg. although the locomotives are designed to traverse curves as sharp as 20 deg.

Since the latter part of 1923, the heavy freight traffic on this division has been handled principally by locomotives of the 2-10-2 type, which were built by the Baldwin Locomotive Works. These locomotives develop a tractive force of 87,100 lb. Four of them, which are equipped with boosters, giving a maximum starting tractive force of nearly 100,000 lb., are used as pushers on the 1.8 per



Great Northern Articulated locomotive which weighs, with tender, 916,500 lb. and develops a tractive force of 127,500 lb.



Elevation and cross-section of Great Northern Mallet locomotive

cent grade. As compared with the road engines of the 2-10-2 type, the new articulated locomotives show an increase in tractive force of nearly 47 per cent.

The largest articulated locomotives heretofore used by the Great Northern are the 25 Mallet compounds of the 2-8-8-0 type, known as Class N-1, which were built by the Baldwin Locomotive Works in 1912. During the past year a number of these locomotives were changed to use high pressure steam in four equal sized cylinders, and the design of the new locomotives was determined after experiments had proved that a material increase in hauling capacity was thus obtained. Track conditions on the Great Northern have been much improved since the Class N-1 locomotives were constructed, and with the wheel loads now permitted it is possible to apply a boiler of sufficient capacity to insure an abundant supply of steam for the four 28-in. by 32-in. cylinders used on the Class R-1-S.

The total weight of these locomotives is 594,940 lb. of which 532,800 lb. is on the drivers, 37,550 lb. on the front truck and 24,590 lb. on the trailing truck. The diameter and stroke of the cylinders are 28-in. by 32-in.; the diameter of the driving wheels is 63 in. With 210 lb. steam pressure and 65 per cent cut-off, a tractive force of 127,500 lb. is developed.

Boiler and equipment

In accordance with the usual practice on this road, the boiler of Class R-1-S is of the Belpaire type. The barrel has a conical connection, and is 100 in. in diameter at the front end, the maximum diameter being 109 in. It is fed by one Sellers non-lifting injector placed on the left side, and by one Elesco exhaust steam injector on the right side. The combustion chamber has a length of 72 in. and the tubes are 24 ft. long. The locomotives, as built, are equipped for oil burning, but the design is so worked out that they can subsequently, if desired, be equipped to burn coal and fitted with arches and mechanical stokers. At present no arch tubes are applied, but a brick wall is placed across the throat of the combustion chamber.

Flexible staybolts are applied in the breaking zones in the sides of the firebox. Hollow stays are used in the back head and back of the brick work and there is a complete installation of flexible bolts in the firebox throat and the combustion chamber.

The main dome is on the third boiler ring, and back of it on the same ring, is a man-hole opening fitted with a depressed cover in which are mounted the whistle and the four safety valves. This arrangement was necessary in order to keep within the over-all height limit.

A throttle valve of the Baldwin balanced type is placed in the main dome, and is connected with the superheater header in the smokebox by means of an internal dry pipe. The steam pipes leading from the superheater header terminate in a second header, placed transversely in the bottom of the smokebox and having connections with two outside steam pipes which lead back to the rear cylinders. The front cylinders receive their steam supply through a centrally located pipe connected to the same header, and having three ball joints. All slip and ball joints are lubricated; oil cups are used on all the packing on the locomotive.

The exhaust from the two front cylinders is conveyed to the nozzle through a pipe placed on the center line and fitted with two ball joints lubricated with oil and one slip joint lubricated with grease. The exhaust pipe from the rear cylinders is placed on the left side and it terminates in an annular opening surrounding the exhaust nozzle of the front cylinders. The steam supply for the Elesco exhaust steam injector is taken from the exhausts of both the front and rear cylinders. This injector is placed under the cab on the right-hand side.

Frame construction and running gear

The frames are 6 in. wide and are spaced 41 in. apart transversely. Special attention has been given to the design of the articulated frame connection. The vertical hinge pin is 6 in. in diameter and is held rigid in the rear cylinder saddle, being secured from turning by a tapered fit and a heavy tapered key. The saddle is bushed and the pin is case-hardened. By holding the pin rigid the wear is taken by the bushed connecting bar, which can be easily rebushed and thus the slack between the two units can be kept at a minimum. Both the vertical and horizontal hinge pins are internally lubricated with grease, which is applied from an easily accessible outside location.

The four cylinders are cast iron and are interchangeable, as are also the front and back pistons, crossheads and connecting rods. Corresponding crank pins, wheels and axles in the front and rear units interchange also. The steam distribution is controlled by 14-in. piston valves which are operated by the Walschaerts valve gear. A Ragonnet, Type B, power reverse mechanism is applied. The reach rod connecting the front and back reverse shafts is placed on the center line of the locomotive with its joint immediately above the articulated frame connection. In this way there is practically no distortion to the movement of the forward valves when the locomotive is traversing a curve. The valves all have 1⅞ in. steam lap and no exhaust clearance and are set with a travel of 6¾ in. and a lead of 3/16 in. The cut-off, when working in full gear, is 65 per cent.

The piston heads are steel of the solid type, fitted with bull rings and packing rings of Baldwin Locomotive Works special iron. The main crank pins are of vanadium steel, hollow bored. With the exception of the front main rod stubs, solid end stubs with floating bushings are used throughout. All the pins are lubricated by means of grease.

The boiler is supported on the front frames by means of a single bearer, located to give an even weight distribution and designed to distribute the load on the frames with a minimum frame stress. A low bearing pressure per square inch is assured by the liberal bearing area provided, and the bearer is designed to permit a rocking movement of the frames without binding. No centering device is applied, experience having proved that its use is unnecessary. The upper castings of the bearer and of the rear cylinder saddle are riveted to the boiler, the liners being placed outside the shell. The forward equalization divides between the second and third pairs of drivers, thus giving a three-point suspension for the front unit.

The front and rear trucks are in many respects similar in construction and have interchangeable wheels and axles. The front truck is center bearing and the rear truck side bearing, the bolsters in each case being suspended on heart shaped links. The transverse distance between the inside faces of the truck tires is 5¾ in., while for the driving tires, it is respectively 53, 53⅜, 53¼ and 53⅛ in. for the first, second, third and fourth pairs of drivers of each group. Flanged tires are used on all the wheels.

Arrangement of the cab

The cab is located sufficiently far back to place all flexible stay-bolts outside, where they are easily accessible. To provide clear vision for the enginemen, the front cab windows are placed in specially designed brass frames which permit the glass to extend the full width of the front panels. Steam piping immediately forward of the cab is placed under the jacket; and this, together with the downward trend of the running boards as they extend forward and the arrangement of all external fittings, gives

the engine crew as clear a vision as can be obtained in a locomotive of this size and type.

These locomotives are equipped with force feed lubricators for the front cylinders, and with flange oilers on the leading drivers of both the front and back units. A drifting valve with the handle conveniently located in the cab, and having a 2½-in. pipe connection to the steam valve stand, supplies steam to the cylinders when drifting. The main steam valve stand is placed on the roof sheet in front of the cab, and there is also an auxiliary steam manifold on the left side of the back head connected to the steam valve stand and serving the blower in the smokebox, the oil atomizer, tank heater, oil heater, cab heater, sprinkler, flange lubricator heater and the force feed lubricator heater. On the right side of the back head is an air manifold, with valves serving the bell ringer, sanders, cylinder cocks for the front unit and cylinder cocks for the back unit. This manifold also has plugged connections for the fire door, tube cleaner and whistle.

The oil burning arrangement has a number of interesting features. The damper controlling the intake of air through the fire pan is automatic in its action, opening by draft and closing by gravity. The fire door is provided with an intake riser through the deck, thus preventing cold air from being drawn into the cab. The firebox has a brick flash wall in the back and all firebox seams are protected from the direct action of the fire by seam fire brick.

In order to prevent the exhaust from the air compressors from drawing on the fire when drifting down long grades, the compressors discharge into a separate header, which provides an atmosphere exhaust.

The tender of this locomotive is carried on two Commonwealth cast steel trucks of the six-wheeled equalized type. The frame is a one-piece, Commonwealth steel casting. The tender is built with a stoker conveyor trough, in view of possibly changing to coal burning in the future. A pilot is placed at the rear end. With a capacity for 16,800 gal. of water and 5,800 gal. of oil, these tenders rank among the largest thus far built.

These locomotives have a height over all of 16 ft. 1 in. and a maximum width of 11 ft. 3 in. The length measured from the face of the engine front bumper to that of the tender rear bumper is 104 ft. 4 in. Further particulars concerning dimensions, weights and proportions are given in the following table:

Railroad	Great Northern
Type of locomotive	2-8-8-2
Service	Freight
Cylinders, diameter and stroke	4-28 in. by 32 in.
Valve gear, type	Walschaert
Valves, piston type, size	14 in.
Maximum travel	6¾ in.
Outside lap	1⅛ in.
Exhaust clearance	None
Lead in full gear	3/16 in.
Cut-off in full gear, per cent	65
Weights in working order:	
On drivers	532,800 lb.
On front truck	37,550 lb.
On trailing truck	24,590 lb.
Total engine	594,940 lb.
Tender	321,560 lb.
Wheel bases:	
Driving	43 ft. 7 in.
Rigid	16 ft. 6 in.
Total engine	58 ft. 2 in.
Total engine and tender	96 ft. 3½ in.
Wheels, diameter outside tires:	
Driving	outside, 63 in; center, 56 in.
Front truck	33 in.
Trailing truck	33 in.
Journals, diameter and length:	
Driving, main	12½ in. by 16 in.
Driving, others	11 in. by 14 in.
Front truck	6½ in. by 12 in.
Trailing truck	6½ in. by 12 in.
Boiler:	
Type	Belpaire
Steam pressure	210 in.
Fuel, kind	Oil
Diameter, first ring, inside	109 in.
Firebox, length and width	144 in. by 108 in.
Arch tubes, number and diameter	None
Combustion chamber length	72 in.
Tubes, number and diameter	310, 2¼ in.
Flues, number and diameter	68, 5½ in.
Length over tube sheets	24 ft.
Grate area	108 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	432 sq. ft.
Tubes and flues	6,710 sq. ft.
Total evaporative	7,142 sq. ft.
Superheating	1,896 sq. ft.
Comb. evaporative and superheating	9,038 sq. ft.
Special equipment:	
Brick arch	No
Superheater	Yes
Feedwater heater	Yes
Stoker	No
Booster	No
Tender:	
Style	Cylindrical
Water capacity	16,800 gal.
Fuel capacity, oil	5,800 gal.
General data estimated:	
Rated tractive force, 65 per cent	127,500 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	89.5
Weight on drivers ÷ tractive force	4.09
Total weight engine ÷ comb. heat. surface	65.7
Boiler proportions:	
Tractive force ÷ comb. heat. surface	14.10
Firebox heat. surface ÷ grate area	4.00
Firebox heat. surface, per cent of evap. heat. surface	6.04
Superheat. surface, per cent of evap. heat. surface	26.5

Report on grates with restricted air openings*

THE Committee on Front Ends, Grates and Ash Pans agreed to limit its report to the results of experiments on the use of restricted air openings in grates, which it had learned were in progress on two western railroads. At this time it is to give only a general statement of the purposes of these tests and some general observations on the results thus far obtained.

On one of the roads referred to, the use of grates with restricted air openings was apparently undertaken primarily because of loss of coal through the grates. This with friable coal which does not soften and coalesce on the grates may assume serious proportions. On the other road the restricted air openings were first used in locomotives burning lignite, and the practice was resorted to chiefly because of the difficulty of maintaining the fire bed in good condition with grates of the ordinary design. It appears therefore, that in both cases restricted air openings in grates have been used largely because the coal to be burned was in some respects unusual, and the committee is of the opinion that such a practice will be justified only under special conditions and that it is not likely to become widespread.

The committee believes that for the majority of railroads and for most of the coals in use the aggregate air opening in grates should continue to be made as great as the circumstances permit. With this understanding we are glad to submit the following statements concerning the practice of restricting the grate openings.

With reference to its experiments the first of the two roads referred to makes the following statement: "We have done a great deal of experimenting with different designs of table grates compared with the standard finger grates such as are ordinarily used in locomotives. We went into this experimental work on account of the waste, due to fuel falling through the finger grate in an unburned or partially burned condition."

The remainder of the statement from this road quoted by the committee may be summarized as follows: Smokebox gas analyses made with the different table grates indicated that there was still four or five per cent of free oxygen in the flue gases so that it seemed feasible to continue to decrease the size of grate openings until the effective air opening had been reduced to about 16 per cent of the total grate area, with ¾-in. circular air open-

*Abstract of report and discussion read at the seventeenth annual convention of the International Railway Fuel Association at Chicago, May 26-29.

ings, tapering to 1 1/16 in. at the bottom of the grate bar. This grate has been found to increase materially the carbon dioxide and to reduce the free oxygen. This road states that tests indicate a saving of about six per cent as compared with finger grates.

The other road referred to is the Northern Pacific. The report quotes a letter from M. A. Daly, general fuel supervisor, with respect to experience in burning Rosebud (lignite) coal mined in Montana. This coal as fired has the following analysis:

Moisture	25.66 per cent
Volatile	28.39 per cent
Fixed carbon	38.59 per cent
Ash	7.36 per cent
Heating value	8,743 B.t.u.

This coal breaks up in burning and is very difficult to keep on the grate, the strong draft lifting it and uncovering thin spots in the fire, when using grates with ¾-in. slotted openings. The grate now used has circular openings ½ in. in diameter at the top and ⅞ in. in diameter at the bottom and gives air openings from 12 to 13½ per cent of the area of the bar, and a few per cent greater air opening when measured in relation to the total grate area. It has been found that these grates also burn such coals as Pittsburgh No. 8 from Ohio and other bituminous coals satisfactorily, as well as the lignite for which they were particularly designed, and slightly increased efficiency is expected from this grate burning these coals when accurate tests are made.

The committee states that Mr. Daly is of the opinion that the success of these grates is not to be ascribed to the reduction in the aggregate air opening, but primarily to the size of the holes through the grate which reduce the force of the jets of air drawn through the grates so that they do not disturb the particles of coal on the grate when the locomotive is working.

The report is signed by Edward C. Schmidt (University of Illinois), Chairman, M. C. M. Hatch (M. K. T.), V. L. Jones (N. Y., N. H & H.), G. H. Likert (U. P.), John P. Neff (American Arch Company), C. B. Smith (B. & M.), F. C. Thayer (Southern), G. A. Young (Purdue University) and F. Zeleny (C. B. & Q).

Discussion

This report led to a lively discussion in which there was considerable disagreement as to the fundamental soundness of going to the restricted air openings described. In the experience of the Atchison, Topeka & Santa Fe with the restricted air openings described, the important points apparently are the saving through the elimination of fire dropping into the ash pan, which formerly required cleaning three or four times over a division, and the ability to maintain a light even fire. The experience on this road has led its officers to believe that sufficient air enters the firebox through the restricted grate openings to maintain satisfactory combustion. It was stated that a saving of about 6 per cent in fuel per unit of work has been observed, although this is not the result of elaborate tests.

Considerable skepticism was voiced as to the combustion efficiency obtained with the grates having the highly restricted air openings, the discussion suggesting that the restricted openings have effected their savings by stopping a heavy loss through the grates rather than by improving combustion conditions.

The evaporative capacity of locomotive boilers

Factors determining the coefficients of the proposed formula—A practical application

By Alexander P. Poperev

Part II

WE have started from an assumption that the evaporative capacity of the locomotive boiler is determined by three factors; namely, the design of the boiler, the kind of fuel and the rate of combustion. Formula (6) shows how the evaporative capacity varies with the rate of combustion, and it remains now to tie up this formula with two other factors, namely, the design of the boiler and the kind of fuel used. In other words, our present problem will be to determine the values of the coefficients in formula (6) for any given boiler and fuel.

The complexity of this problem and the difficulties connected with it can be readily appreciated, particularly if we take into account the great variety of fuels used as well as variations in the design of boilers, on the one hand, and the scarcity of suitable experimental data, which can be used for this purpose, on the other. The latter consideration presented most of the difficulties and proved to be the greatest obstacle in extending the scope of the present work.

The method, adopted by the writer for attacking this problem, was as follows: Inspection of experimental data suitable for our purpose on the evaporative performance of the locomotive boiler has shown that while they referred to a great variety of locomotive boilers, there were only two kinds of fuel used, each of fairly uniform quality. Accordingly, all the available data were segregated into two groups, according to the fuel used. This enabled us to eliminate one variable factor, the fuel, and to analyze the effect of the design of a boiler on its evaporative performance. For this purpose the values of the equivalent rate of evaporation for every locomotive in each group were plotted against corresponding rates of combustion, and the equation of a representative curve, which would agree well with the experimental data and yet satisfy formula (6) was then determined. Thus the values of the coefficients a, b and c of formula (6) were obtained for every locomotive. As the fuel in each group of data was, for all practical purposes, of the same quality, the values of the coefficients of formula (6) for each

group could be considered in accordance with our assumption as being dependent on only one variable; namely, the design of the boiler.

In order to determine the factor representing the effect of the boiler design, the obtained values of the coefficients of formula (6) were plotted against different boiler ratios. After a number of trials it was found that a smooth curve was obtained only when the values of the coefficients were plotted against the ratio,

$$R = \frac{\text{Heating surface}}{\text{Grate area}}$$

showing thereby the existence of a definite relationship between these quantities. Therefore, this ratio has been chosen as a factor representing the effect of boiler design. This should not be entirely unexpected, if we recall that the coefficients of formula (6), as it was shown above, actually represent various heat losses in the boiler expressed in terms of the equivalent rate of evaporation. From general considerations and partly from experiment we know that there exists a certain proportionality between various heat losses and the ratio R, as naturally the heat in the boiler will be utilized the better, the greater will be the amount of heating surface with respect to the grate area and vice versa.

As some of the locomotives used in the tests had a superheater, the question arose, what value of heating surface has to be taken in the determination of the ratio R. There is no fixed relation between the evaporating and superheating surfaces and as the problem concerned primarily the determination of evaporative capacity of the locomotive boiler, with all the simplification possible, it suggested itself to determine the ratio R as

$$R = \frac{\text{evaporating heating surface (excluding superheater)}}{\text{grate area}}$$

in all cases, irrespective of whether there was a superheater or not. The trials showed, that in this way the difficulty due to the presence of the superheater could be obviated, provided that the corresponding values of the equivalent rate of evaporation are calculated on the basis of heat transferred through the evaporating heating surface only; in other words, as if the boiler had no superheater at all. Accordingly, only these values of the equivalent rate of evaporation were used, and they were denoted by Z_e, in order to distinguish them from values which are usually calculated on the basis of total heat in a pound of steam.

Once a proper factor representing the effect of the design of the boiler was established, there was little difficulty in finding an empirical equation for the relationship between the values of the coefficients in formula (6) and the ratio R. In the course of determining these equations, it has been found that boilers equipped with arches have to be segregated in a separate group, as the presence of the arch produces a marked effect on the proportion of the various heat losses. Finally all available experimental data were classified into the following groups:

1—Bituminous coal.
 a—Boilers, with arch.
 b—Boilers, without arch.
2—Semibituminous coal.
 a—Boilers, with arch.
 b—Boilers, without arch.

Unfortunately, the available experimental data referring to tests with semibituminous coal and boilers without the arch were not sufficiently complete and as a result, the corresponding equations for this group were not determined. The dimensions of the boilers, the fuel used and the references from which the corresponding experimental data used for the determination of these equations were taken are listed in Table I. It is shown in this table that the ratio R varies from 33.29 up to 79.56, which covers the entire range used in practice.

TABLE I

Dimensions of boilers and kind of fuel used in experiments

	Type of locomotive and serial No.	H_e Evaporating heating surface (excluding superheater) sq. ft.	G Grate area sq. ft.	Ratio $R = \frac{H_e}{G}$	Heating value of 1 lb. of dry coal B.t.u.	% of volatile matter	References
Bituminous coal Boilers with arch	E3SD-318	1820.9	54.7	33.29	14,392	34.46	Penna. R.R. Co. Test. Dept. Bulletin No. 11
	E6S-89	2400.7	55.23	43.70	14,470	33.66	Penna. R.R. Co. Test. Dept. Bulletin No. 21
	E6S-51	2586.0	55.79	46.51	14,470	33.65	Penna. R.R. Co. Test. Dept. Bulletin No. 27
	L-1-S-1752	3676.1	70.05	52.49	14,140	31.59	Penna. R.R. Co. Test. Dept. Bulletin No. 28
	K4S-1737	3692.1	69.26	53.31	14,467	34.88	Penna. R.R. Co. Test. Dept. Bulletin No. 29
	I1S-790	3944.2	70.0	56.35	13,425	30.51	Penna. R.R. Co. Test. Dept. Bulletin No. 31
	K2SA-877	3323.1	55.72	61.86	14,530	36.08	Penna. R.R. Co. Test. Dept. Bulletin No. 18
Semi-bituminous coal Boilers with arch	Jacobs-Shuppert and radial stay boilers	2996.4	58.1	51.56	14,728	16.45	Tests of Jacobs-Shuppert Boiler - Dr. Goss.
	Consolidation No. 586	2819.2	49.45	57.03	14,913	16.25	The Penna. R.R. Co. at Louisiana Purchase Exposition - Chapter 15
	Vauclain 4 cyl. cpd. No. 535	2902.1	48.36	60.01	14,967	16.25	The Penna. R.R. Co. at Louisiana Purchase Exposition - Chapter 18
	Cole 4 cyl. cpd. No. 3000	3000.0	49.9	60.12	14,989	16.25	The Penna. R.R. Co. at Louisiana Purchase Exposition - Chapter 20
	L.S. & M.S. Ry. No. 734	2541.22	33.76	75.27	14,907	16.25	The Penna. R.R. Co. at Louisiana Purchase Exposition - Chapter 14
	De Glehn cpd. No. 2512	2565.5	33.39	79.56	14,916	16.25	The Penna. R.R. Co. at Louisiana Purchase Exposition - Chapter 17
Semi-bituminous coal Boilers without arch	E-2A No. 5266	2319.3	55.5	41.79	15,143	16.13	Penna. R.R. Co. Test. Dept. Bulletin No. 5
	Simple Consolid. No. 1499	2482.3	49.21	50.44	14,141	16.25	Penna. R.R. Co. at Louisiana Purchase Exposition - Chapter 13
	Hannover cpd. No. 628	1753.2	29.06	50.56	14,998	16.25	Penna. R.R. Co. at Louisiana Purchase Exposition - Chapter 19
	Jacobs-Shuppert and radial stay boilers	2996.4	58,10	51.56	14,806	16.45	Tests of Jacobs-Shuppert Boiler - Dr. Goss.
	Schenectady No. 3	943.0	17.0	55.47	14,347	15.25	Superheated steam in Locomotive Service - Dr. Goss.
	Tand. cpd. Santa Fe No. 929	4306.13	58.41	73.73	15,007	16.25	Penna. R.R. Co. at Louisiana Purchase Exposition - Chapter 16

The results obtained—Values of the coefficients of formula (6) and their equations

The physical significance of the coefficient a is, as it has been shown, a heat loss due to radiation, leaks, etc.,

expressed in terms of the equivalent rate of evaporation. This kind of loss is naturally totally independent of the kind of fuel used and being calculated per unit of heating surface of a boiler, may be considered without any serious error as constant for all designs of locomotive boilers. The actual values of coefficient *a* obtained for different locomotives varied but little from each other and an average value of 0.4 was accepted as a representative value of this coefficient for any boiler or fuel. It is interesting to note, that according to Dr. Goss's[1] experiments with stationary locomotive boilers, the total heat loss at the beginning of cooling off was equal to 273,000 B.t.u. per hour, which in terms of equivalent rate of evaporation amounted to 0.231 lb. per sq. ft. per hour. During motion the average heat loss amounted to 6,000 B.t.u. per minute or 0.305 lb. per sq. ft. per hour in terms of equivalent evaporation. In other words, the value obtained for the coefficient *a* comes very near to the experimental data.

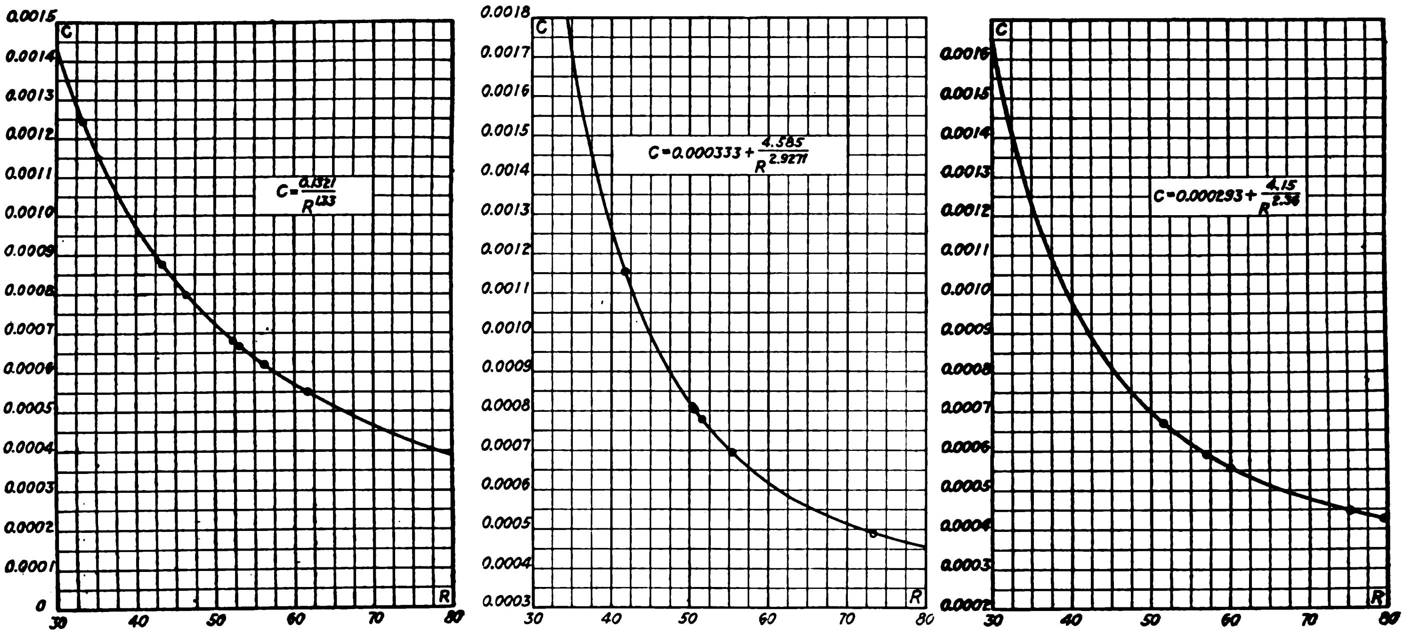


Fig. 1—Charts showing values of coefficient C.—The left is for bituminous coal and boilers having an arch; two others for semi-bituminous coal; center—for boilers without an arch; right—for boilers having an arch

It has been shown[2], that the coefficient *b* of formula (6) can be considered as consisting of two terms;

$$b = \frac{KG}{Hr} - n = \frac{K}{Rr} - n,$$

of which the first represents the theoretical value of the rate of evaporation, corresponding to the rate of combustion equal unity, and the second term, *n*, represents a certain summary loss, directly proportional to the rate of combustion. It is the relationship between this heat loss and the size and type of the boiler that we are interested in establishing because the value of $\frac{K}{Rr}$ can always be easily calculated for any given boiler and fuel. Accordingly, values of *n* were determined (from found values of coefficient *b*) for every locomotive in each group and plotted against corresponding values of *R*. The following relationships were thus established:

[1]Locomotive Performance, by Dr. W. F. Goss, pp. 186, 216.
[2]August, 1924, *Railway Mechanical Engineer*, p. 491.

Bituminous coal—for boilers having an arch:

$$(7) \quad \dots\dots\dots \quad n = \frac{0.3294}{e^{0.0363R}}$$

Semi-bituminous coal for boilers having an arch:

$$(8) \quad \dots\dots\dots \quad n = \frac{0.08368}{e^{0.00679R}}$$

Semi-bituminous coal—for boilers without an arch:

$$(9) \quad \dots\dots\dots \quad n = \frac{7.0}{R^{1.173}}$$

In equations (7) and (8), *e* is the base of the natural logarithms. Knowing the value of *n*, the value of the coefficient *b* can be calculated very easily.

The following expressions have been found to express the relationship between the values of the coefficient *c* and the ratio *R*:

Bituminous coal—for boilers having an arch:

$$(10) \quad \dots\dots\dots \quad c = \frac{0.1321}{R^{1.33}}$$

Semibituminous coal—for boilers having an arch:

$$(11) \quad \dots\dots\dots \quad c = 0.000293 + \frac{4.15}{R^{2.36}}$$

Semibituminous coal—for boilers without an arch:

$$(12) \quad \dots\dots\dots \quad c = 0.000333 + \frac{4.585}{R^{2.9271}}$$

Graphs of the above expression are shown in Figs. 1, 2 and 3.

Resulting equations for the evaporative capacity of the locomotive boiler

The resulting equations for the evaporative capacity of the locomotive boiler for different conditions can thus be presented as follows:

Bituminous coal—for boilers having an arch:

$$(13) \quad \dots\dots \quad Z_e = -0.4 + \left(\frac{K}{Rr} - \frac{0.3294}{e^{0.0363}R}\right) Y - \frac{0.1321}{R^{1.33}} Y^2$$

Semibituminous coal—for boilers having an arch:

$$(14) \quad . \quad Z_e = -0.4 + \left(\frac{K}{Rr} - \frac{0.08368}{e^{0.00679}R}\right) Y - \left(0.000293 + \frac{4.15}{R^{2.36}}\right) Y^2$$

Semibituminous coal—for boilers without an arch:

$$(15) \quad . \quad Z_e = -0.4 + \left(\frac{K}{Rr} - \frac{7.0}{R^{1.173}}\right) Y - \left(0.000333 + \frac{4.585}{R^{2.9271}}\right) Y^2$$

In all the above formulas:

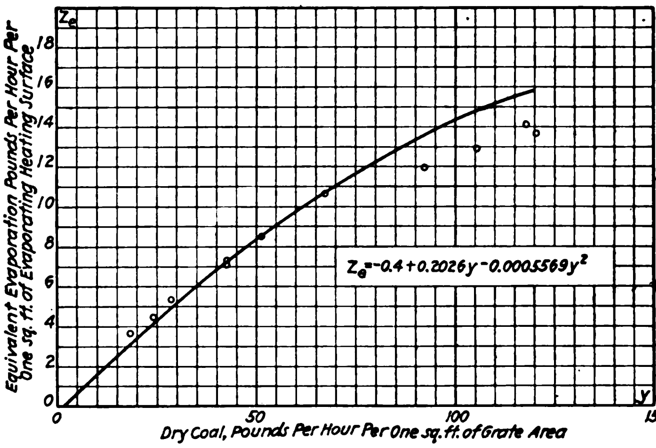
Z_e = the equivalent rate of evaporation, from and at 212 deg. F., of wet steam in lb. per sq. ft. of evaporative heating surface (excluding the superheater) per hour.
Y = the rate of combustion in pounds of dry coal per sq. ft. of grate area, per hour.
R = the ratio of evaporating heating surface (excluding the superheater) to grate area.
r = the heat of vaporization from and at 212 deg. F.
K = the heating value of 1 lb. of dry fuel in B.t.u.
e = 2.7183, the base of the natural logarithms.

One must not, of course, consider the above expressions as exact or final; the experimental data on which they are based were none too numerous and like every empirical equation, they are subject to corrections with the further accumulation of experimental data, particularly in the values of the coefficients. However, in nearly all of the nineteen locomotives which were analyzed and enumerated in Table I, they come to a rather surprising close agreement with experimental data. Lack of space prevents the showing of plots for every locomotive. Those, which are shown here, as well as in Part I of this article are fairly representative for the large majority of the plots. Only in very few cases was there a disagreement which did not exceed 15 per cent between the values determined by the above formulas, values obtained from experiment. The disagreement manifested itself however mostly at rather high rates of combustion. Considering this we must have in view a few cases, taken from the Pennsylvania tests, in which attention has been called to the fact, that there was noticed at the higher rates of combustion an insufficient air supply, and the evaporation was below normal; besides, the experimental data per se are hardly more accurate, at the best, than within 10 or 15 per cent.

It is believed, however, that even with this inaccuracy the suggested expressions will be found useful in ordinary influence of this factor in the formulas. The experiments must be complete to obtain definite results.

Diagram for the evaporative capacity of the locomotive boiler

Despite every attempt to simplify the problem as much as possible, the resulting expressions obtained are too



Curve showing the evaporative capacity of the Vauclain four-cylinder compound No. 535—Boiler dimensions and kind of fuel used is shown in Table I

complicated to be conveniently used in practice. However, a diagram, embodying these expressions can be easily constructed, by means of which all necessary calculations can be performed in the most simple manner.

The diagram, shown in Fig. 4, consists of four

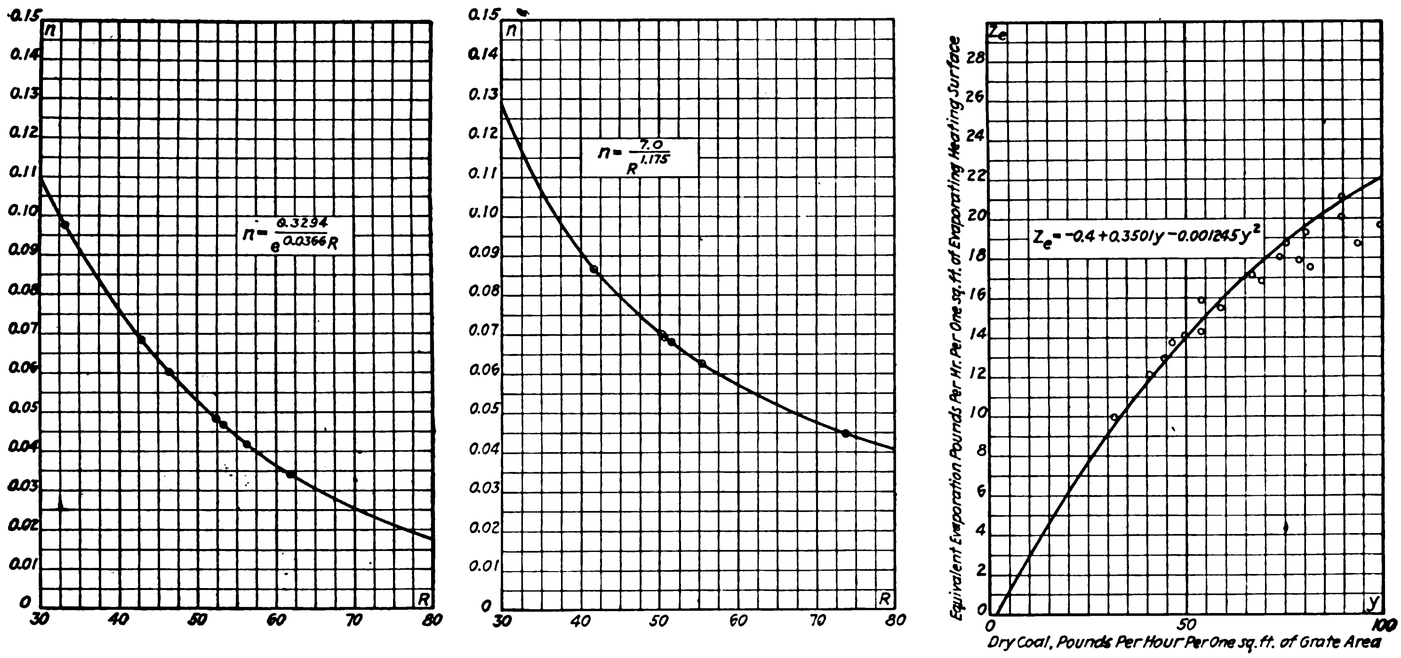


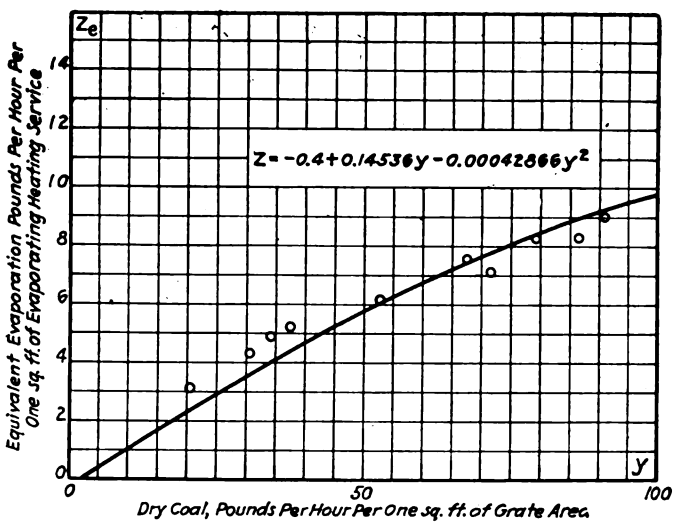
Fig. 2—First two charts show values of coefficient n: Left—for bituminous coal and boilers having an arch; Center—for semi-bituminous coal and boilers without an arch. Right—Curve showing evaporative capacity of Pennsylvania locomotive No. 318, class E 3S D

practice, as they permit one to estimate the probable evaporative capacity of the locomotive boiler with greater accuracy than with any of the other existing formulas. No doubt, with the accumulation of experimental data it will be found possible to increase the accuracy still more, particularly when experiments with a greater variety of fuels would permit one more accurately to account for the quadrants. In the upper right quadrant the values of the coefficient $b = \dfrac{K}{Rr} - n$ for different values of K are plotted as ordinates against corresponding values of R as abscissae. Now for any given value of y the quantity by, which represents the second term in formula (6), can be represented by a straight line, when referred to

*See the *Railway Mechanical Engineer* for August, 1925, page 491.

the co-ordinate axes O-B and O-P. Such lines are plotted in the upper left quadrant for different values of y, from $y = 10$ lb. per sq. ft. up to $y = 150$ lb. per sq. ft., and the result is read off on the axis O-P. In the lower right quadrant are plotted as ordinates the values of the coefficient c of the formula (6) against corresponding values of R as abscissae. Again, for every given value of y, the expression $a + cy^2$ being referred to the co-ordinate axes O-C and O-Q can be represented by a straight line. These lines are drawn in the lower left quadrant, likewise for different values of y, from $y = 10$ lb. per sq. ft. up to $y = 150$ lb. per sq. ft., and the result is read off on the axis O-Q, which, for convenience, has a double scale compared with that of the axis O-P. Thus, the construction of the diagram does not present any difficulties, particularly if we remember that for the construction of every straight line in both the left hand quadrants, it is necessary to calculate only two values of the corresponding expressions by and $-(a + cy^2)$.

The method of using the diagram will be clear from the following example. Suppose we want to find the value of Z_e for $y = 100$ lb. per sq. ft. for a boiler having an arch and having the ratio $R = \frac{H_e}{G} = \frac{3676.1}{70.03} = 52.49$, the fuel being bituminous coal having a heating value of 14,140 B.t.u. per pound of dry coal. On the axis O-R we read of the value $R = 52.49$ and from this point follow up vertically to the intersecting point q with a curve in the upper quadrant, corresponding to the heating value for the coal of 14,140 B.t.u. From this point we proceed parallel to the axis of abscissae until we intersect the straight line in the upper left hand quadrant corresponding to $y = 100$ lb. per sq. ft. at the point s. On the axis O-P we read of the value of by equal to, say, 23.0.



Curve showing the evaporative capacity of a cross-compound consolidation locomotive, shown in Table I as No. 585

Starting again from the point t on the axis O-R and proceeding this time downward, parallel to the axis of ordinates, up to the intersection point u on the curve C, and from it horizontally up to the intersection (point v) with the straight line in the lower left hand quadrant corresponding to $y = 100$ lb. per sq. ft., we read on the axis O-Q a value, say 7.2. By subtracting it from the value found before we obtain a value for Z_e corresponding to $y = 100$ lb. per sq. ft.

$$Z_e = 23.0 - 7.2 = 15.8 \text{ lb. per sq. ft. per hour.}$$

Obviously, the same simple procedure applies to finding the value Z_e for any value of y.

Other relationships derived from formula (6)

While the relationship between the rate of evaporation and the rate of combustion represents a basic relationship which fully characterizes the performance of a boiler, it is desirable sometimes to know how other factors—for instance, the efficiency of the boiler, or rate of evaporation per pound of fuel—vary with the rate of combustion. It can be easily shown that once the relationship between the rate of evaporation and the rate of combustion is established for any given conditions, all these relationships can be very easily derived from the formula (6). As an example we shall consider here the derivation of the formulas for the relationship between the rate of combustion and the efficiency of the boiler, as well as the rate of evaporation per pound of fuel.

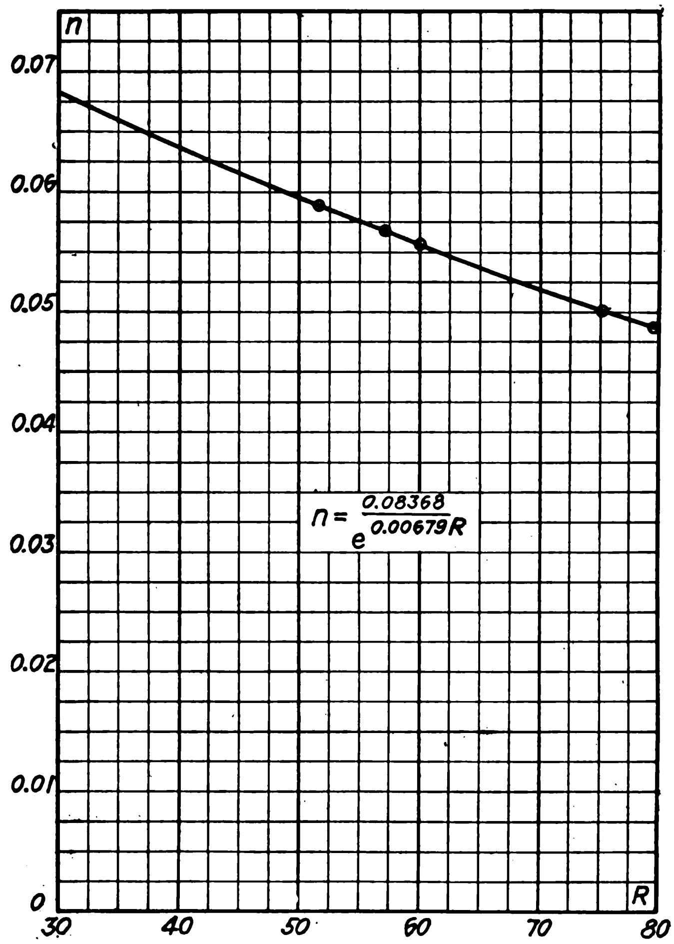


Fig. 3—Curve showing the values of the coefficient *n* for semi-bituminous coal and boilers having an arch

From the general definition of the efficiency of the boiler

$$\text{Eff.} = \frac{\text{Heat utilized}}{\text{Heat consumed}}$$

and using the same notations for the heating surface, grate area, rates of evaporation and combustion as above, we have

$$(16) \qquad \text{Eff.} = \frac{HZr}{KGy}$$

substituting in equation (16) the expression for Z according to formula (6) we have

$$\text{Eff.} = \frac{Hr}{KG}\left(\frac{-a + by - cy^2}{y}\right)$$

$$= \frac{Hr}{KG}\left(-\frac{a}{y} + b - cy\right)$$

For any given boiler and fuel the factor $\frac{Hr}{KG} = \frac{Rr}{K}$ is constant and therefore we can write

$$\text{(17)} \quad \text{Eff.} = -\frac{p}{y} + q - sy$$

where $p = \frac{Hr}{KG} a$; $q = \frac{Hr}{KG} b$, and $s = \frac{Hr}{KG} c$ are constants for a given boiler and fuel.

$$\text{(18)} \quad y_{\text{max. eff.}} = \sqrt{\frac{p}{s}}$$

Substituting this in (17) we obtain the maximum value of the efficiency of the boiler as

$$\text{(19)} \quad \text{Eff.}_{\text{max.}} = q - 2\sqrt{ps}$$

From formula (6) it is also very easy to derive, in the same way as above, an expression for the relationship between the rate of evaporation per pound of fuel and the rate of combustion. The rate of evaporation per

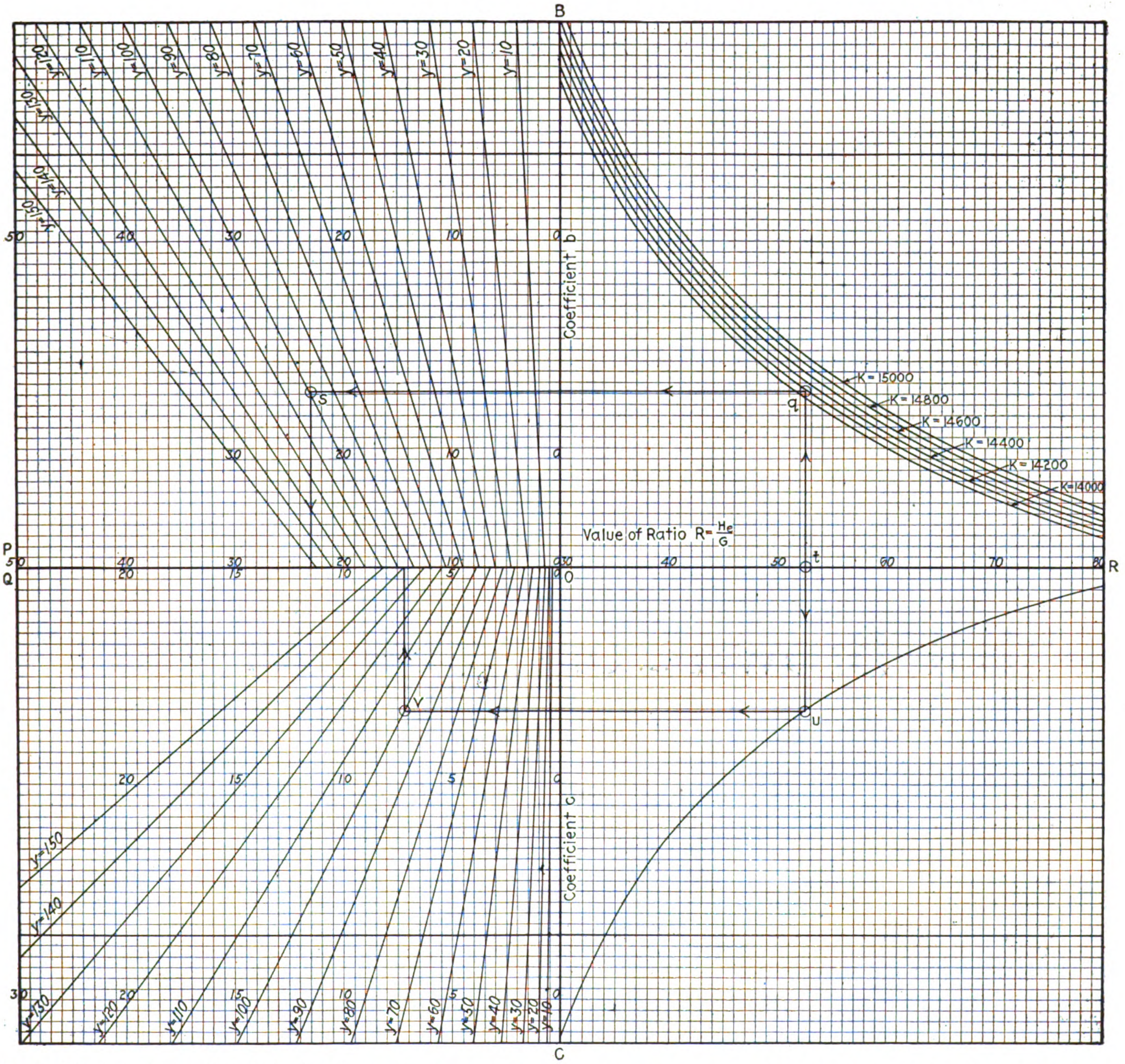


Fig. 4—Diagram for use in calculating the evaporative capacity of locomotive boilers having an arch and fired with bituminous coal

The formula (17) represents the expression of the relationship between the efficiency of a boiler and the rate of combustion and is the equation of a hyperbola. It permits us to determine the maximum value of the efficiency of the boiler, as well as the rate of combustion at which it occurs.

By differentiating formula (17) we obtain the value of the rate of combustion corresponding to a maximum value of the efficiency of the boiler

pound of fuel evidently can be expressed in the following way

$$\text{(20)} \quad f = \frac{ZH}{Gy} = \frac{ZR}{y}$$

Substituting the expression for Z from formula (6), we have

$$f = \frac{ZR}{y} = \frac{(-a + by - cy^2)R}{y}$$

and as $R = \frac{H}{G}$ is constant for a given boiler and fuel, we have

$$f = \frac{-aR}{y} + bR - cRy =$$

$$(21) \quad = -\frac{m}{y} + t - vy$$

where

$$m = aR;\ t = bR, \text{ and } v = cR$$

are constants for a given boiler and fuel.

The maximum value of the rate of evaporation per

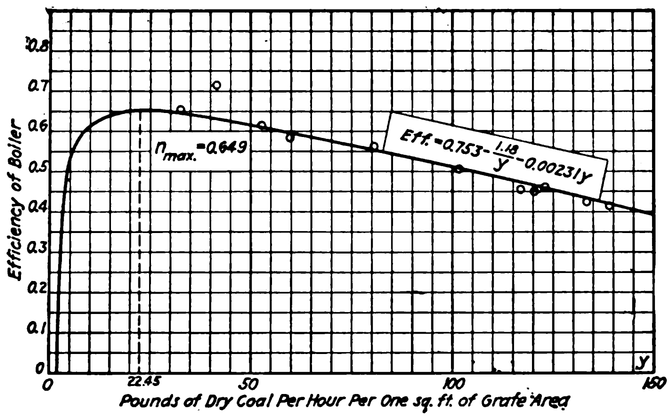


Fig. 5—Curve showing the relationship between the boiler efficiency and rate of combustion—Data taken from Pennsylvania R. R. Tests

pound of fuel will be found in a similar manner as follows:

$$(22) \quad f_{max.} = t - 2\sqrt{mv}$$

and the corresponding rate of combustion

$$(23) \quad y \text{ f equals max.} = \sqrt{\frac{m}{u}}$$

Figs. 5 and 6 illustrate the application of the above expressions to experimental data. As it can be seen from the plots, the maximum of both the efficiency and the rate of evaporation per pound of fuel occurs at rather low rates of combustion, which are not only outside of

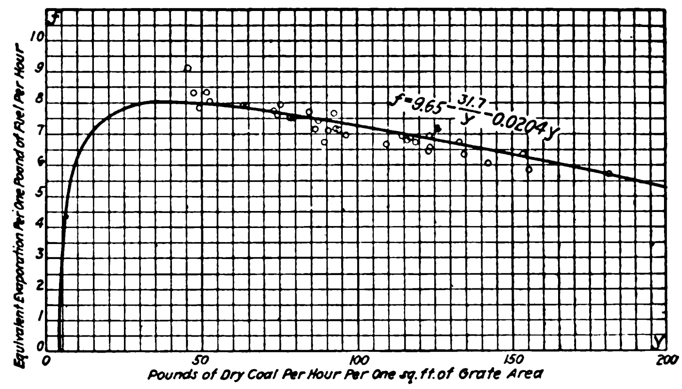


Fig. 6—Curve showing the relationship between the rate of evaporation per pound of fuel and the rate of combustion—Data taken from Dr. Goss' tests

the usual service range, but also usually outside of the experimental range. To this fact can be attributed many wrong conclusions in regard to the nature of these relationship between the rate of evaporation and the rate of combustion. On the contrary, by applying the same analysis to expressions (17) and (21), we fail to find any similar contradictions, which fact can be considered as an additional proof that the basic expression (6), from which these formulas are derived, is correct.

"Bill Brown" or "Top Sergeant" —which?

Our readers, judging from the letters to the editor, are taking a keen interest in this controversy

NATURALLY there are a great many differences of opinion as to the duties and responsibilities of foremen and supervisory officers. The first prize article in the *Railway Mechanical Engineer* competition on the opportunities and responsibilities of the foreman, written by "Bill Brown" was published in the June *Railway Mechanical Engineer;* three communications concerning it appeared in the August number, page 492. Two of the writers backed up "Bill Brown" and enlarged upon some of his suggestions. "Top Sergeant," however, drastically criticized him.

Shortly after the distribution of the August number we began to receive communications, the first three more or less unreservedly backing up "Bill Brown" and taking issue with "Top Sergeant." The fact that these letters came from such widely scattered sections as Michigan, Texas and Ohio made it look as if there was nothing to the controversy and that "Bill Brown" would walk away with all the honors. Later mails, however, brought letters of a very different sort, either strongly supporting the position of "Top Sergeant" or criticizing "Bill Brown." A selection from these communications follows. Which side do you agree with?

"Top Sergeant" a supreme egotist

Galveston, Tex.

To the editor:

The letter on page 492 of your August issue may perhaps be somewhat of a surprise to those higher railway officers who may chance to read it.

It is not often that a person of the calibre of "Top Sergeant" has either the intelligence or the audacity to set down his candid opinions in black and white. Unfortunately, however, his kind are only too numerous in minor supervisory positions in the railway service, and his remarks should be earnestly recommended to the careful perusal and consideration of those executives who are constantly bewailing the lack of "loyalty and co-operation" on the part of their employees.

"Top Sergeant" betrays his supreme egotism in his

attitude toward the railway trade journals, although he seems able to spare sufficient of his valuable time to keep posted on the work of his favorite cartoonists. In view of his extraordinary complete knowledge of railway mechanical engineering, one wonders why he chooses to remain in a subordinate position rather than engage in more remunerative consulting practice where he will have sufficient time to study and read literature that will tend to broaden his mind and dispel his pessimistic views of his fellowmen.

Were it not for the fact that he is deadly earnest, "Top Sergeant's" letter, which is but the pathetic effusion of a small and reactionary mind, would deserve a position on the humorous page.

An ex-apprentice boy,
Alfred M. Hallington.

The foreman—a superman?

Railroad Shop.

To the editor:

"Bill Brown," the author of the prize article on "The Foreman and His Responsibility" is surely an optimist and has kidded himself into looking at the bright side of the picture. Your editorial in the June number indicated that he was a successful shop superintendent. I wonder whether his position is not such that he is too far above the department foremen and does not understand all of the difficulties that they are up against in these days.

I have been a foreman in the machine shop for many years. Twenty years ago we did not have any of these high-fangled notions about dealing with the men and we managed to get along pretty well. I have 40 men under me and it keeps me mighty busy seeing that they are on the job and that the finished material gets to the erecting side in time not to delay the locomotives. My shoe bill is a heavy one, because I have to cover a lot of ground every day and there is little time or opportunity for going into the fine points of dealing with the workers. The grievance committee is going to keep busy anyway and it is a waste of time for me to worry much about the boys, whose leaders are working overtime to look after their interests. I have all I can do to keep things moving.

Another thing—it would appear that some sort of a superman is required to fill the foreman's position. You want a man to be a master craftsman, to carry all the responsibilities of getting output and dealing with other departments, and on top of this to be an expert on management—a regular operating vice-president. And what do we get out of it? A lot of responsibility and worry and a little more money than an ordinary mechanic. We have no union looking after our welfare and interests and we are even "docked" for being sick or taking a vacation.

You will probably not dare to publish this, but why side-step the real issue? If you are going to try to start something, why not come clean and lay all the cards on the table, face up? Please consider as confidential my real name and location.

"Bill Black."

"Top Sergeant" cold-blooded

Michigan.

To the editor:

The commentary of the "Top Sergeant" in the August *Railway Mechanical Engineer* discloses that there still exists a railroad supervisor lacking in that primary attribute to the successful handling of men and problems—"latitude and thought."

We are no longer in the era of "constituted authority" which was the law of the masters, but in a community of interest where every man feels a sense of responsibility to both the company and his fellowmen. The masters of finance and industry have themselves become reconciled to this inevitable fact. Public opinion is its pathfinder; it is founded on the teaching of Christ—justice, sympathy and kindness. Discipline, however, need not be compromised. This we can administer without entailing sacrifice. These sentiments appeal to decency and the hearts of men and make for loyalty and happiness, and the germ when fertilized will permeate the atmosphere, infecting those in all departments and everyone will thereby profit.

The inference of "Top Sergeant" that the army countenances the practice he advocates is folly. As an officer of the Engineers, U. S. A., where discipline is a primary factor, I never witnessed such cold blooded treatment of men. If a "Top Kick" of mine had attempted to exert his will by coercion, I would have immediately "busted" him and put him in the ranks.

A measure of a man's ability to forge ahead is directly proportioned to his willingness and ability to study, accept and assimilate new laws and ideas. It isn't so much what he knows, as it is how he came to know what he knows. In the case of the "Top Kick" he accepts no new ideas from any source—management, salesmen, mankind, or otherwise. How supreme and secure he must feel in his limited domain. It is inconceivable to me that a man could be inspired to take such an attitude toward his fellowmen. It tinges with the deliberations of one soured on labor, management, self and mankind generally.

Captain Blood.

Backs up "Top Sergeant"

New Jersey.

To the editor:

I am very much interested in the discussion which "Bill Brown's" article has stirred up and wish to take this occasion to say my hat is off to the "Top Sergeant."

Here in my opinion as a railroad shop foreman who *knows* how to handle his men and get a real day's work out of every one of them. I will bet the cigars any time that "Top Sergeant" can take "Bill Brown's" gang and not only get greater outputs but also make such a favorable impression upon the men that if they were given their choice they would prefer to stay in "Top Sergeant's" gang.

No other industry or vocation has ever produced a finer body of men than our American railroads, but up to the present time of writing not one department has yet reached that mollycoddle stage where the men expect to be petted and coaxed into doing their day's work. The supervisor who has the courage to say: "By G—! I want it done this way and right away," never fails to get the cooperation which produces the desired output.

I fully agree with "Top Sergeant" that there is altogether too much of this brotherly love stuff being spilled. It may work out all right in fiction or the movies but in actual practice you will find it a pretty tough job to keep down the cost of production after you once start singing sentimental lullabys to your men. I also believe as the "Top Sergeant" that "Bill Brown" has missed his vocation and should be addressing audiences from the pulpit and not from a work bench on the shop floor.

Mr. Editor, if you really wish to learn something about how much sentiment there is in the human nature that a shop foreman has to contend with, just make arrangements with some railroad to temporarily masquerade yourself in this capacity and address your prospective gang in the manner "Bill Brown" advocates. I warn

you right now to be mentally prepared for the biggest razzing you ever got in your life.

It does not require much of an imagination to picture the delightful atmosphere of congeniality that must prevail in "Bill Brown's" department—what a wonderful improvement over the Garden of Eden it must be—where new workmen are cordially invited to take off their hats, get acquainted and are informed to be very careful about straining themselves for a few days; where a royal welcome awaits every so-called sales engineer who has a mythical story of wonderful tool performances to relate—where operators are expected to stop their machines while retrieving some valuable nut or bolt and where the foreman has time to make a scientific study of the men's point of view and then makes allowances for the cussedness found in human nature.

It may be that the railroads are now looking for the kind of shop foreman "Bill Brown" recommends but I personally will doubt it until the day arrives when I am paid to visit other shops for observant purposes—until I have once been allowed to select a machine tool which I know my department badly needs and until there is no longer need for a foreman to scour the scrap yard for a couple of apprentice boys who prefer to consume their "Lucky Strikes" on the company's time.

F. O. Reman.

"Objects to 'Top Sergeant's" arguments

Lorain, Ohio.

To the editor:

"Bill Brown" certainly did start something as evidenced by "Top Sergeant's" comments in the August *Railway Mechanical Engineer,* page 493. It is good to get the viewpoint of men, and without quarreling with their ideas we may at least try to prove or contest the soundness or practicability of their methods in dealing with employees or other affairs in their shops.

"Top Sergeant," I have read carefully your comments. You may be a top sergeant for all I know or care, but from a mere shopman's point of view, "granted that your opinions express your methods," you belong to a class of supervisors which is rapidly disappearing. Adopting the attitude of, "I am Monarch of all I survey; there is none my power to dispute," may be to you the essence of glory, but to the man in the shop it is ridiculous.

Your first contention, Why should a shopman play in the town band? Well, why don't you deny him the right to be a church member or an attendant at Sunday school? There would be just as much sense to it.

Second, calling his men together for a talk. That one item, proven by experience, has done more for production and general welfare than all the "drivers" in the world got out of their men.

Third, reading the railway journals. Why, my dear old top, your very words show how necessary it is that you get those bundles of journals out of their covers. Read, learn and digest!

Fourth, new employees. Did you ever stop to consider that no matter how good and experienced the new man may be, it takes a little time for him to accustom himself to his new surroundings, and the best mechanic that ever lived would need more than twenty minutes to prove his ability to a "hard-boiled" guy?

Fifth, new tools. Sure, you are not reading the journals and their advertisements, so you can't very well know, but lots of us know that the shop tools now being sold are far in advance of some sold two years ago.

Sixth, sales engineers. Have not had any experience with them, so cannot express any opinion.

Seventh, conservation of material. For this we agree as one of the best ideas put forward by the railroads, but, "Serge," if "Bill" dropped the only one inch nut he had, would you insist that he get an order for another instead of picking that one up?

Eighth, relationship to foremen of other departments. No, it is not Sunday school stuff, but good business sense. You can have competition between the different departments without bucking one another.

Ninth, attitude towards apprentices. At the recent centennial celebration of Akron, Ohio, among the exhibits were working models of both steam and electrical driven locomotives, complete to the minutest detail, the building of which, we were told, was done entirely by the apprentices of different railroads. Such work could not have been done by apprentices that were treated "rough" as you advocate. The August *Railway Mechanical Engineer,* page 511, contains a report of work done by apprentices of the Kansas City Southern, also showing their photographs. Do they look like a lot of dumb-driven cattle, as evidently you would have them?

"Top Sergeant," your comments are not in line with present-day tendencies, which are far superior to those of days gone by. Again, let me ask you to read your journals; come out from behind the clouds and into the light of day.

Joseph Smith,
Boilermaker, Baltimore & Ohio.

Slave-drivers not wanted

Bristol, Va.

To the editor:

"Top Sergeant's" viewpoint and treatment of the men under him are the principal causes of most of this dissatisfaction and unrest among workingmen today.

No man in authority who is clothed in his right mind wants a large labor turnover. Yet how can a man such as "Top Sergeant" expect any man to want to work for him? Everyone, with the exception of a few "Top Sergeants," has agreed that the contented workman is the best workman. A man cannot be contented working for a sour, fault-finding, get-to-hell foreman.

A foreman of the "Top Sergeant" variety is out of place in the railroad shop of today. The few that are left should be relegated to the corn and cotton fields, and to the construction camps, there to end their days viewing the business end of a mule in their daily toil, where they can vent their spleen to their heart's content. Their mouthings will be lost on the mule and will harm no one but themselves.

Although I am not in the mechanical department, I am glad that I work for a railroad where the management believes in treating the employees as human beings.

Buck Private.

H. J. Forster, secretary of the American Railway Association, announces that the modifications of car service Rule 11, set forth in his circular No. 2524 have been adopted by the association, as shown by the letter ballot which he recently recorded. This rule provides for marking freight cars with both nominal capacity and load limit, and for showing the cubical capacity with the inside dimensions.

Bulletin No. 9 has been issued by the Railway & Locomotive Historical Society, 6 Orkney Road, Brookline, Mass. The principal article is a 12-page sketch of the history of the Portland Company, Portland, Maine, as a former prominent builder of locomotives. This company, still flourishing in other lines, has built no locomotives since 1907. In 1852 it built the first locomotives for the Panama Railroad, and in 1882-83 built 100 for the Northern Pacific. Another bit of history contained in this pamphlet says that the New York & Erie, in 1856, employed 500 men, owned 203 locomotives and had a telegraph with 60 telegraph agents "so that any occurrence on the road could be instantly made known to the officers."

S. P. and U. P. acquire three-cylinder 4-10-2 locomotives

Tractive force of S. P. with booster is 95,700 *lb. and that of U. P. with no booster is* 78,000 *lb.*

RECENTLY the American Locomotive Company, New York, delivered to the Southern Pacific 16 three-cylinder locomotives of the 4-10-2 type and one of the same type to the Union Pacific. These locomotives have a new wheel arrangement which is a development from the 2-10-2 type in which the two-wheel leading truck has been replaced by a four-wheel truck.

The Southern Pacific locomotives, which will be known on that road as the Southern Pacific type, are used for hauling passenger and freight trains over the Sierra Nevada mountains where the maximum grade is 2.2 per cent. The Union Pacific locomotive, which will be known as the Union Pacific Overland type, has been operated for some time on the western end of the road and its performance is also to be carefully observed on all the other lines of the system: namely, the Los Angeles & Salt Lake, Oregon Short Line and the Oregon-Washington Railroad & Navigation Company.

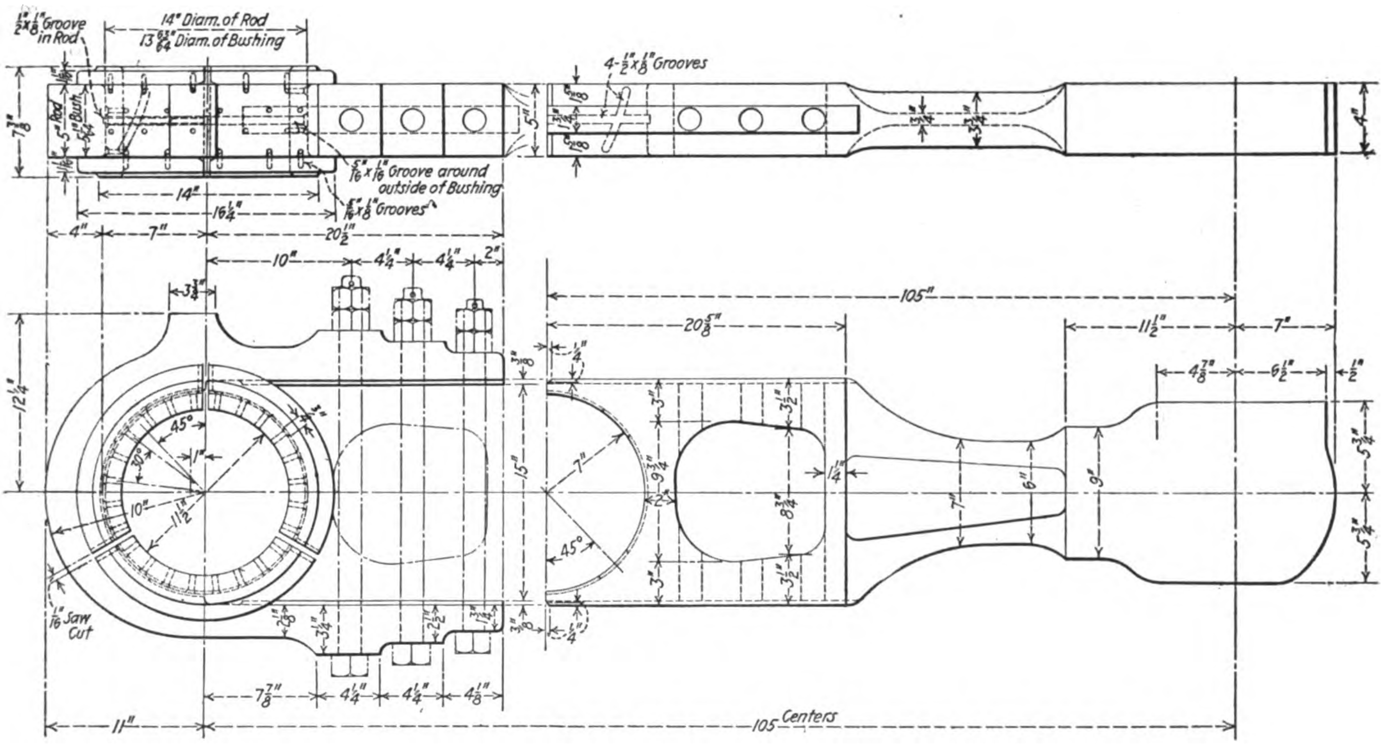
The Southern Pacific locomotives weigh 442,000 lb., of which 316,000 lb. is on the drivers, 65,500 lb. on the front truck and 60,500 lb. on the rear truck. They carry 225 lb. boiler pressure; the cylinders are 25 in. in diameter, the strokes being 32 in. outside and 28 in. inside, and the driving wheels are 63½ in. in diameter. With a maximum cut-off of 70 per cent, they develop a tractive force of 83,500 lb., which is increased to 95,700 lb. by the trailer booster. These are the most powerful non-articulated locomotives yet built. They burn oil and are equipped with Worthington feedwater heaters.

The Union Pacific locomotive weighs 405,000 lb., of which 288,500 lb. is on the drivers, 60,000 lb. on the front truck and 56,500 lb. on the rear truck. It carries 210 lb. boiler pressure and, like the Southern Pacific locomotives, the cylinders are 25 in. in diameter. The stroke of the outside cylinders, however, is 30 in., while that of the inside cylinder is the same as on the Southern Pacific locomotives. The driving wheels are 63 in. in diameter. With a maximum cut-off of 85 per cent a tractive force of 78,000 lb. is developed. Semi-bituminous coal is used as a fuel and is fired with an Elvin stoker.

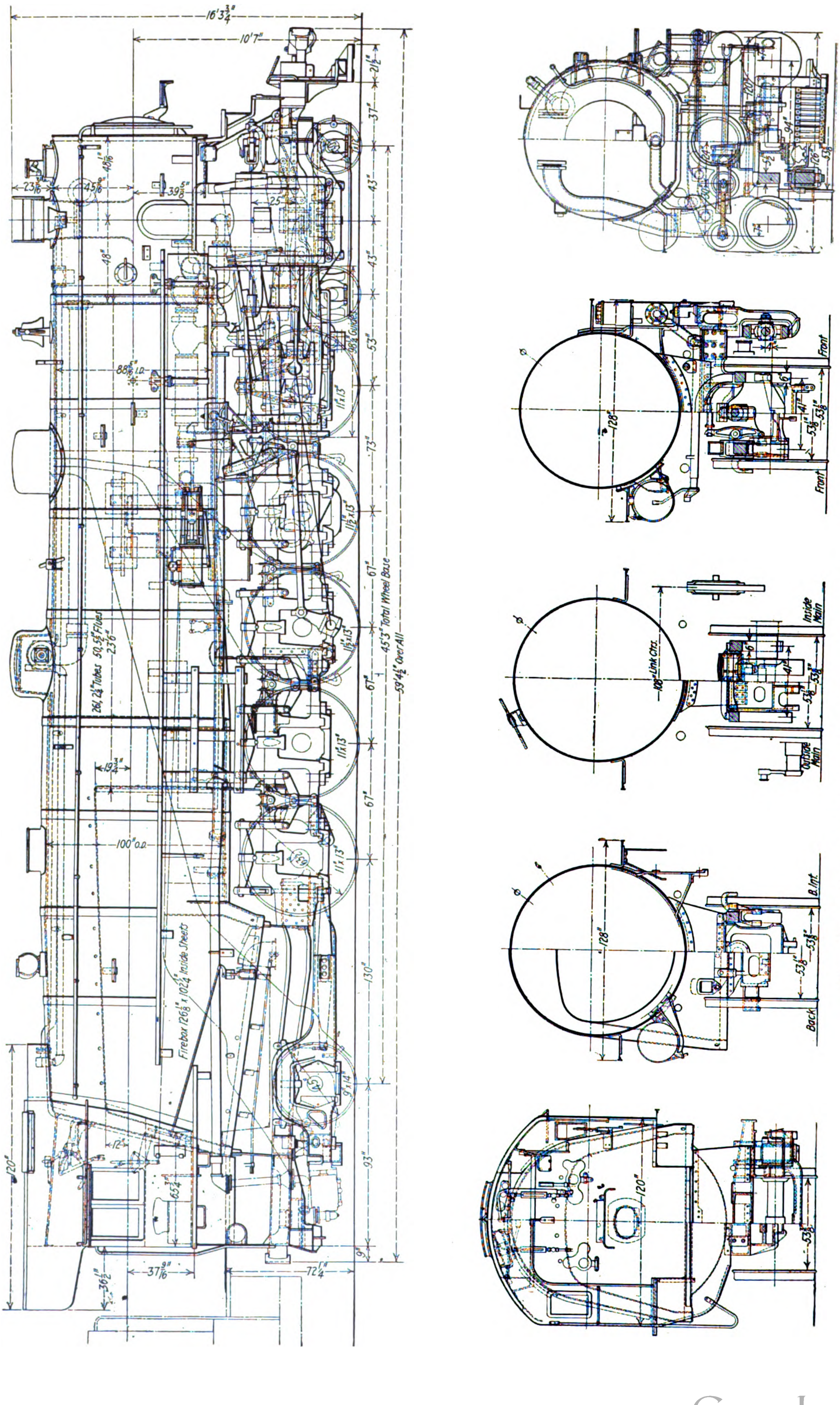
Boiler equipment

The boilers of these locomotives do not differ materially from the usual type of design. The overall length of the Union Pacific boiler is 49 ft. 7-7/16 in., while that of the Southern Pacific is 49 ft. 1¾ in. The other general dimensions of the Union Pacific boiler are slightly smaller than those of the Southern Pacific. The boilers of the locomotives of both companies are equipped with 50-unit Type superheaters.

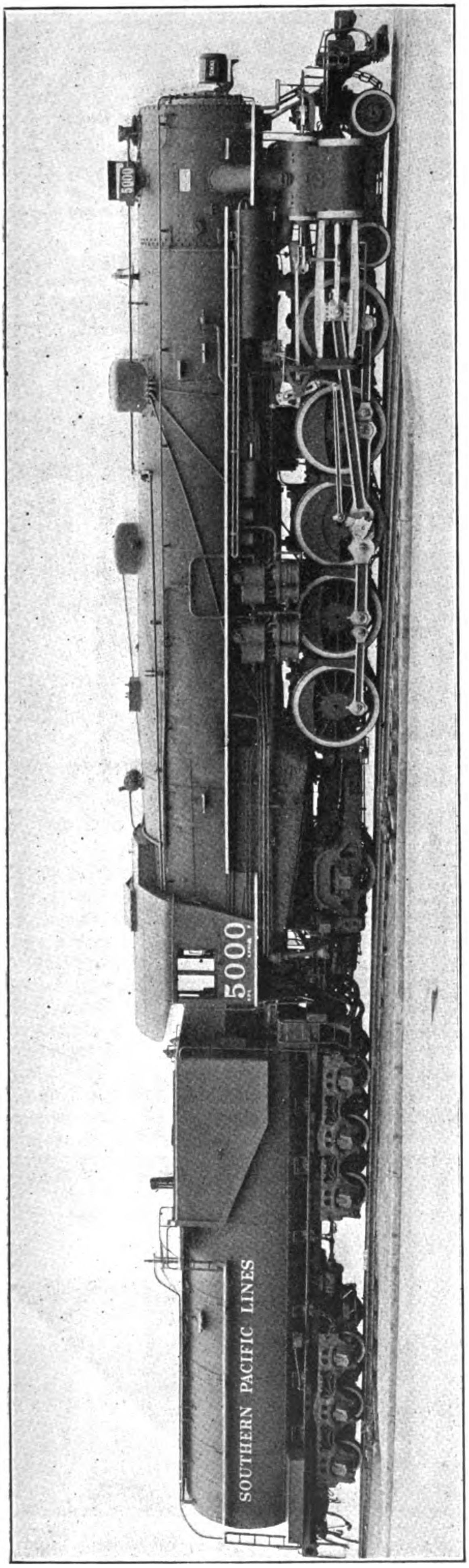
In the Southern Pacific locomotives the Bradford front end throttle is used which is located in the superheater smokebox between the superheater and the main steam cylinders. This provides superheated steam for operating auxiliaries, such as the air compressors, feedwater heater, headlight generator, oil atomizer and the blower. Two Westinghouse cross-compound air compressors are mounted on the right side of the locomotive beneath the



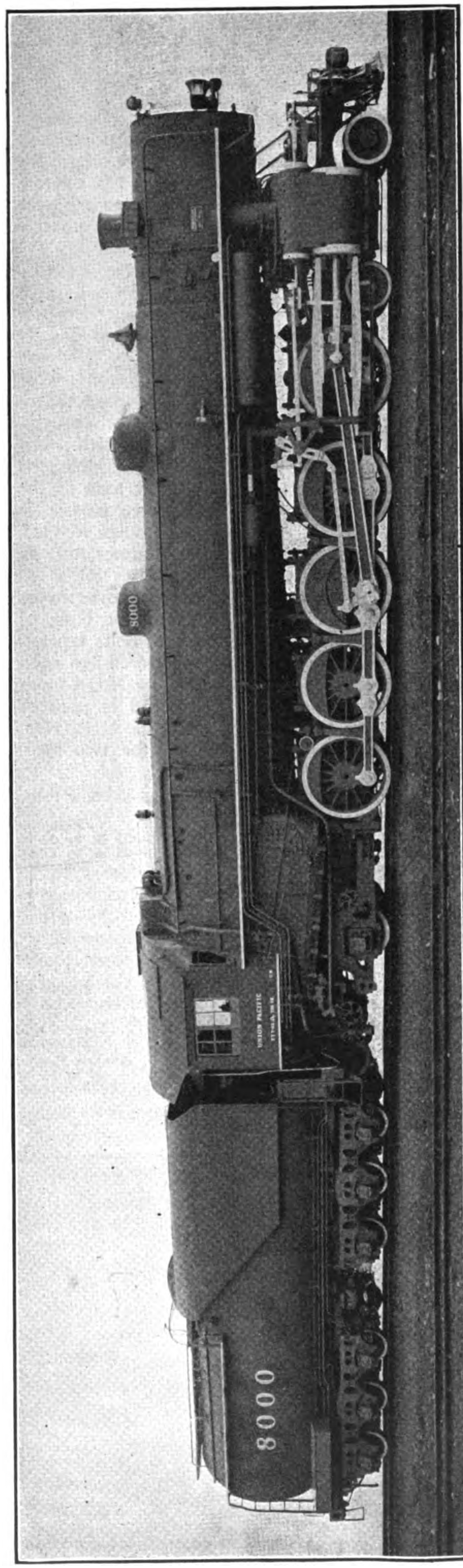
Middle main driving rod designed with an adjustable front end with rotor bushings and a strap back end with floating bushings



Elevation and cross sections of the 4-10-2 Type Southern Pacific locomotive



Southern Pacific, three cylinder, 4-10-2 Type locomotive which develops a tractive force of 83,500 lb. at 70 per cent cut off and 95,700 lb. with the booster, making it a powerful non-articulated locomotive



Union Pacific, three cylinder 4-10-2 type locomotive which develops a tractive force of 78,000 lb. at 85 per cent cut-off and 210 lb. boiler pressure—Total weight of locomotive, 405,000 lb. and with tender 647,500 lb.

running board, while on the Union Pacific the same size New York air compressors are mounted on the left side of the locomotive.

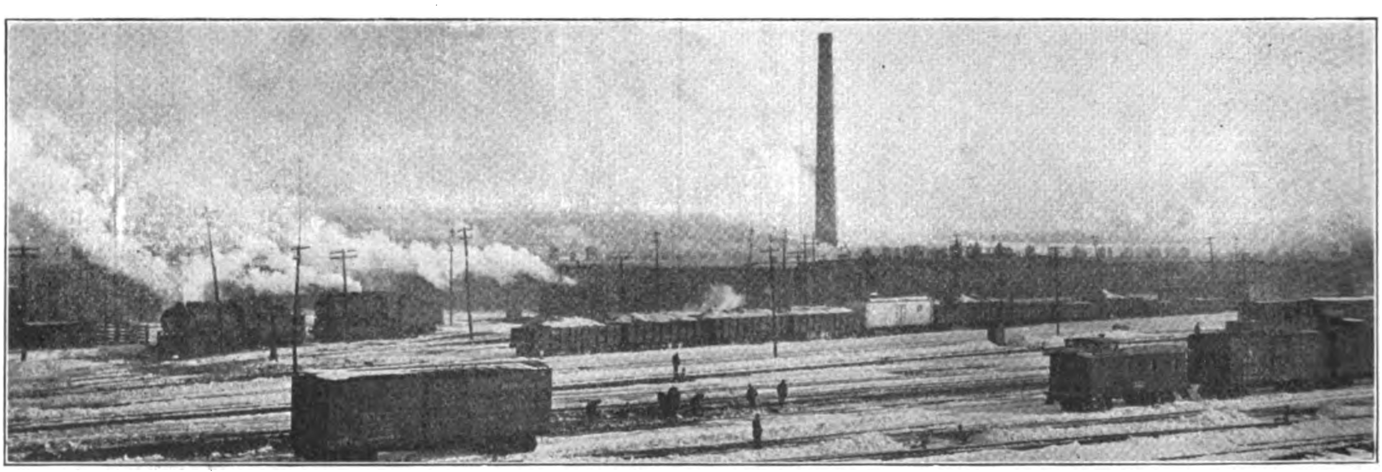
Running gear

Steam distribution is controlled by the usual outside valve gear. The valve stems of the two outside steam chests are extended and are connected just ahead of the chests by the same arrangement of levers used to operate the valve for the third cylinder on the three-cylinder locomotives previously built by the American Locomotive Company. The valve chambers of these locomotives are bushed to take 11-in. piston valves. They are operated by the Walschaert gear, controlled by the Alco Type E power reverse gear on the Southern Pacific engines and by the Franklin precision gear on the Union Pacific locomotive.

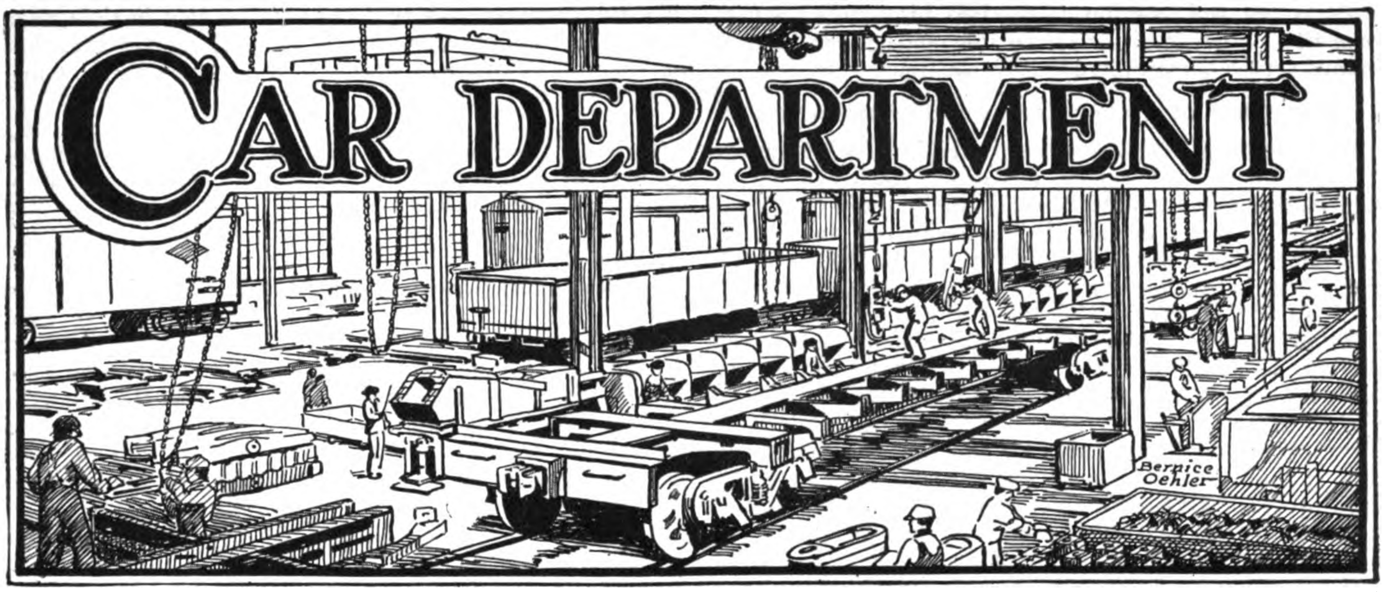
The middle main rod of a three-cylinder locomotive is rather difficult to get at for repairs. In order to reduce the wear of the bushings to a minimum, these rods are provided with an adjustable front end with rotor bushings and a strap back end with floating bushings. The back bushing, which fits over the crank axle of the second pair of drivers, is divided into three parts. It contains four rows of 5/16-in. holes, 12 holes in each row, alternately spaced. The holes are countersunk ¾ in. on the outside. This arrangement provides for equal distribution of the lubricant as the bushing moves in its fit around the pin. The strap dovetails on the body of the rod and is held in place by three 1¾-in. bolts tapered 1/16 in. in 12 in. Two nuts are put on the end of each bolt which are prevented from coming off by No. 4 taper pins, 2½ in. long. The weight of the rod is reduced by an opening through back end of the rod.

The principal dimensions and data for the two locomotives are shown in the following table:

Railroad	Union Pacific	Southern Pacific
Type of locomotive	4-10-2	4-10-2
Service	Passenger	Passenger
Cylinders, diameter and stroke	2—25 in. by 30 in. 1—25 in. by 28 in.	2—25 in. by 32 in. 1—25 in. by 28 in.
Valve gear, type	Walschaert	Walschaert
Valves, piston type, size	11 in.	11 in.
Maximum travel	6¼ in.	6 in.
Outside lap	1⅛ in.	1½ in.
Exhaust clearance	None	1/16 in.
Lead in full gear	3/16 in.	3/16 in.
Cut-off in full gear, per cent	85	70
Weights in working order:		
On drivers	288,500 lb.	316,000 lb.
On front truck	60,000 lb.	65,500 lb.
On trailing truck	56,500 lb.	60,500 lb.
Total engine	405,000 lb.	442,000 lb.
Tender	242,500 lb.	244,000 lb.
Wheel bases:	Union Pacific	Southern Pacific
Driving	22 ft. 6 in.	22 ft. 10 in.
Rigid	16 ft. 6 in.	16 ft. 9 in.
Total engine	44 ft. 1 in.	45 ft. 3 in.
Total engine and tender	82 ft. 5 in.	87 ft. 3¼ in.
Wheels, diameter outside tires:		
Driving	63 in.	63½ in.
Front truck	30 in.	30 in.
Trailing truck	45 in.	45½ in.
Journals, diameter and length:	and sec. 11 in. by	and second 11½ in by
Driving, main	12 in.	13 in.
Driving, others	10 in. by 12 in.	11 in. by 13 in.
Front truck	6½ in. by 12 in.	7 in. by 12 in.
Trailing truck	9 in. by 14 in.	9 in. by 14 in.
Boiler:		
Type	Inverted wagon top	Inverted wagon top
Steam pressure	210 lb.	225 lb.
Fuel, kind	Semi-bituminous	Oil
Diameter, first ring inside	86¼ in.	88 5/16 in.
Firebox, length and width	126 in. by 96 in.	126⅛ in. by 102¼ in.
Height mud ring to crown sheet, back	75⅛ in.	70 in.
Height mud ring to crown sheet, front	87⅛ in.	88 in.
Arch tubes, number	4	None
Combustion chamber length	60¼ in.	74in.
Tubes, number and diameter	250—2¼ in.	261—2¼ in.
Flues, number and diameter	50—5½ in.	50—5½ in.
Length over tube sheets	23 ft. 6 in.	23 ft. 6 in.
Tube spacing	13/16 in.	13/16 in.
Flue spacing	13/16 in.	13/16 in.
Grate area	84 sq. ft.	89.6 sq. ft.
Heating surfaces:		
Firebox and comb. chamber	362 sq. ft.	390 sq. ft.
Arch tubes	28 sq. ft.	....
Tubes	3,497 sq. ft.	3,600 sq. ft.
Flues	1,685 sq. ft.	1,686 sq. ft.
Total evaporative	5,522 sq. ft.	5,676 sq. ft.
Superheating	1,505 sq. ft	1,500 sq. ft.
Comb. evaporative and superheating	7,027 sq. ft.	7,176 sq. ft.
Special equipment:		
Brick arch	Yes	Yes
Superheater	Yes	Yes
Feedwater heater	No	Yes
Stoker	Yes	No
Booster	No	Yes
Tender:		
Style	Cylindrical	Cylindrical
Water capacity	12,000 gal.	12,000 gal.
Fuel capacity	20 tons	(oil) 4,400 gal.
General data estimated:		
Rated tractive force, 85 per cent	78,000 lb.	70 per cent—83,500 lb.
Weight proportions:		
Weight on drivers ÷ total weight engine, per cent	71.2	71.6
Weight on drivers ÷ tractive force	3.69	3.61
Total weight engine ÷ comb. heat. surface	57.7	61.5
Boiler proportions:		
Tractive force ÷ comb. heat. surface	11.11	11.63
Tractive force X dia. drivers ÷ comb. heat. surface	6.99	7.38
Firebox heat. surface ÷ grate area	4.31	4.35
Firebox heat. surface, per cent of evap. heat surface	6.56	6.87
Superheat, surface, per cent of evap. heat. surface	27.21	26.41
Comb. heat surface ÷ grate area	83.6	79.9



Now is the time to check up on terminal conditions and see what should be done to get ready for winter



Freight car maintenance problems*

Need of improvements in design in order to reduce repair costs—Modern shops and equipment should be provided

By C. G. Juneau
Master car builder, Chicago, Minneapolis & St. Paul, Milwaukee, Wis.

UNDOUBTEDLY, the greatest problem today in connection with freight car maintenance revolves on the constant endeavor of the railroads to obtain the maximum use of the car unit. The utilization of cars is the product of their loading and their movement. Successful attempts are continually being made to load each car with greater tonnage and to increase the distance each car is hauled per day. Again, wherever there is an opportunity to fit the trains to the traffic, this is being done so that the tonnage will be handled in fewer trains, and thus effect a saving in those transportation expenses that fluctuate with train mileage. The trend of this endeavor on the part of the railroads to obtain greater use of their cars and trains is pictured in Fig. 1.

Result of increased weight and capacity

Along with this steady increase in the utilization of the freight car, has gone a steady change in the construction and strength of the car. The all wooden car is fast disappearing and its place is being filled by the composite car and the steel car. During the past twenty years the average carrying capacity of a freight car has increased from 29.4 tons in 1903 to 43.1 tons in 1922. The light weight of cars has also increased. The all-wooden box cars acquired in the 1890's weighed from 14½ tons to 16 tons whereas the composite box cars acquired in 1919 weighed 23½ tons. Fig. 2 shows the replacement of the all-wooden freight car by the composite and the steel car. Fig. 3 shows the increase in the average carrying capacity of freight cars of the country and pictures the trend of increased light weight of cars as shown in the case of box cars.

These changes in the weight and capacity of the freight car have resulted in its increased punishment. Although freight cars have been greatly strengthened to meet the additional burdens placed upon them, and while there is really no disagreement throughout the country covering the strength requirements of these cars, the railroads do, however, continue to have bad order cars in great numbers. What is actually occurring is increased punishment to freight equipment because of the lack of cushion formerly provided in train movement by reason of the wooden car disappearing. If operating methods are to proceed as in the past, there is absolutely no question but what resilience will have to be furnished through the medium of a suitably designed draft rigging, or else we may expect distinct failure of parts following a progressive cycle, depending upon considerations of relative strength factors.

Furthermore, while the freight car as a whole has been designed and constructed to meet modern operating conditions, many of its parts are not equal to the tasks imposed. The draft gear seems to be about the weakest part of most cars, when, as aforementioned, it must be depended on to lessen the punishment received by the car. Very little has been done to improve the foundation brake rigging, and air brake apparatus on the modern car is compared to the old unit, and yet experience shows the air brakes are responsible for approximately one-fourth of the transportation delay to cars made in bad order in train yards and running repair tracks. Rail-

* Contributed by the Railroad Division at the Spring Meeting, Milwaukee, Wis., May 18 to 21, 1925, of the American Society of Mechanical Engineers.

roads cannot well continue accepting this kind of a performance if they desire to keep the modern car in continuous service a maximum amount of time.

Importance of proper design and construction

The design and construction of freight cars was never of more importance than it is today. Each acquisition of new equipment should be made the subject of special study by the mechanical and transportation officers to determine; first, the actual necessity for the cars; second, the size and capacity which will give the greatest net returns to the company, and third, the type of car. A thorough study of the design should be made before any cars are built. It is undoubtedly true that maintenance expenses are considerably increased due to failure to take everything into consideration when preparing the designs. The only way to insure that new cars when acquired will be a credit to the mechanical department, is to keep designs of each type constantly under way. Each detail must be critically analyzed, compared with existing types and an endeavor made to eliminate its defects. A comparison of the final result with the original will usually show a surprising number of changes, and will convince any one of the necessity of giving long and painstaking attention to every new design.

Few cars designed today can be criticized as lacking in strength in the essential parts, but it is also important that cars should be light, so they can consistently be made easy to repair, and well protected against corrosion. Few cars meet all these requirements, and their failure to do so has led to severe criticism of car design from a maintenance and operating standpoint.

In the matter of designing and constructing a modern car, the details of material, as previously mentioned, cannot be judged entirely from strength requirements. The question of deterioration over a period of years needs to be given serious thought. If a roof becomes defective in one-half the time that the rest of the principal portions of the car require attention, and has to be repaired, the car is held out of service. This emphasizes the need of studying the parts in relation to their cycles of renewals, so that they may be grouped and consequently reduce the days detained on the repair tracks.

Sources of deterioration of freight cars

One of the greatest sources of deterioration of freight cars, irrespective of the material or construction, is corrosion or decay, which continuously exerts its destructive influence whether the equipment is in service or not. In the case of wood parts there are very few renewals which are not directly caused or at least greatly hastened by decay. A close analysis of failures which appear to be purely mechanical will generally disclose the gradual destruction of the piece by decay as the original source of weakness. The matter, therefore, of preventing the destruction of material, by chemical action in the case of metal and by the propagation and growth of the destroying fungi in the case of wood, is worthy of considerable study.

A car must also be considered from the standpoint of items effected by friction or transportation such as wheels, brake shoes, draft rigging, couplers and the trucks as a whole. The wear and failure of these parts constantly increases with the greater utilization obtained from the modern car. To withstand this greater hardship it is essential that proper designs and proper material be employed in each case. The use of correct metals and alloys requires a more thorough study. Certainly we never should use a brittle steel for parts subject to great shocks, or soft iron for parts subject to much friction, yet this has been done, resulting in failures. Sills, framing members, etc., are subject to strains that in time wear them out. These parts must be of such construction that shocks and vibrations incident to the service will not impair their efficiency.

Consideration should be given to building a car strong enough to meet general requirements and yet so put together, materials and otherwise, as not to be unduly heavy. In other words, cars should be designed to have a high ratio of load to total weight. This is important because dead weight is a factor in train movement. A five year average of the freight trains handled on one western road showed that for each net ton of revenue freight carried, the train hauled 1.2 tons of dead weight, exclusive of locomotive and tender. Approximately, 66 per cent of the cars hauled were loaded. It is a well-known fact that automobile manufacturers have made successful attempts to reduce the weight of automobiles, yet retaining or increasing their loading capacity. Certainly this matter needs very serious study on the part of car designers.

It is not a good policy to sacrifice materially the design of a car to accommodate details. Standards, however, are unquestionably excellent. At the present time details that will absolutely interchange between all different cars are too few. As long as cars are built for some particular service we may expect to have a difference in construction due to the commodity to be transported. The present tendency is toward refinement in car design and if it

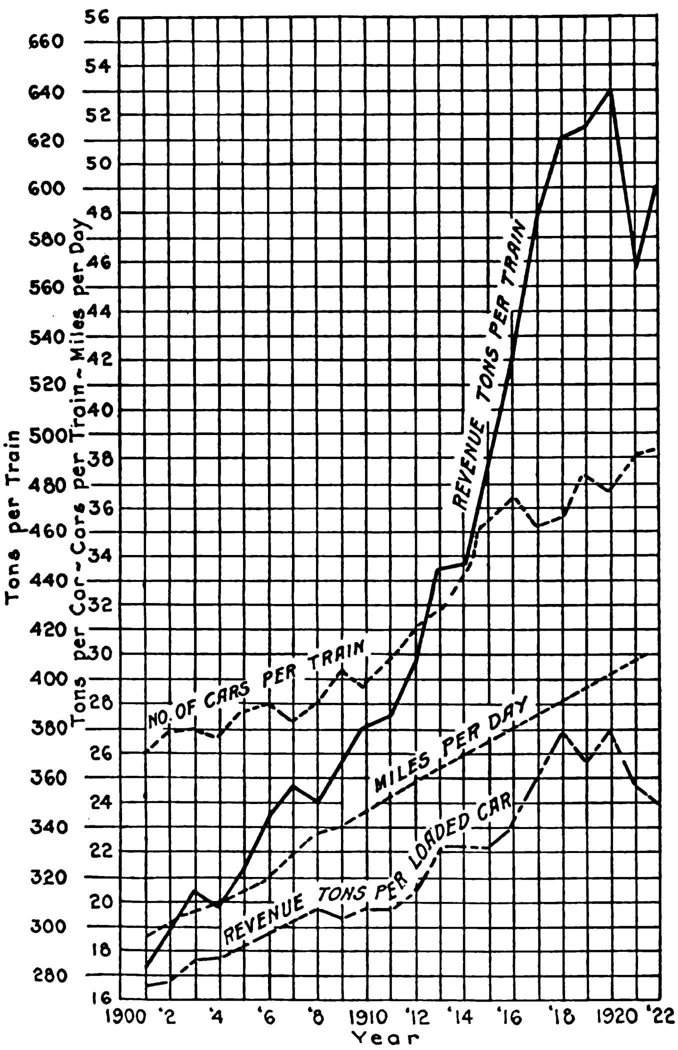


Fig. 1—Chart showing the increase in freight car utilization since 1900

continues, equipment built a few years hence will probably be radically different from what is considered standard practice today. Already a remarkable number and variety of new designs of cars have been introduced.

In the matter of maintaining freight cars it must be continually kept in mind that cars that can be kept in continuous service with a minimum cost of maintenance

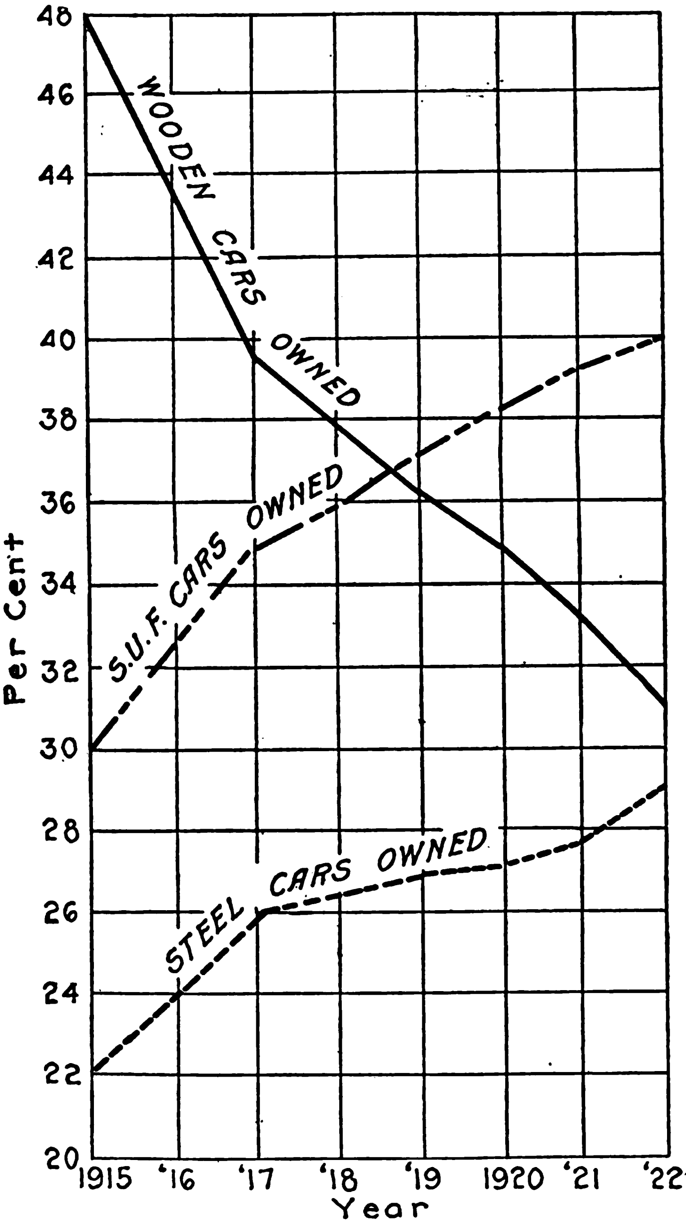


Fig. 2—Chart showing the replacement of wooden freight cars by those of composite and all-steel construction since 1915

and which are sufficiently efficient to protect the lading in transit, mean dollars and cents to the railways. One road found that during a five years' period the cars on its line averaged between 25 to 56 days per year in bad order; also that the frequency of repairs averaged between 22 to 34 times per year. In other words a defect occurred for about every 500 miles the car moved.

Freight cars subject to many defects

Freight cars are subject to many defects which make them unfit to operate. Some are of little consequence; others require considerable time and labor to repair. In general, freight car repairs are governed by frequent renewal of certain parts and infrequent renewal of other parts. Freight car repairs are roughly divided into two classes: light and heavy. Light repairs consist of work done to offset current wear, breakages and loss of parts accruing from ordinary handling and movements of cars day by day. Heavy repairs accrue, generally speaking, from three different sources: wrecks, ordinary wear and tear as accumulated over a period of years, natural deterioration, and obsolescence.

To a certain extent, the problem of handling light repairs is readily dealt with; that is, given a reasonably adequate supply of tools, material and standard parts, and a certain force of men, that part of the maintenance problem will take care of itself and cars will be switched on and off of the rip track daily without much fluctuation. It has generally been found that six light repair cars are repaired during the day to every one left over at the end of the day, and it is this feature of the work which results mostly in an increase or decrease in the bad order car situation.

The situation with respect to heavy car repairs is entirely different. Repairs to cars due to wrecks and accumulated ordinary wear and tear are usually accomplished by replacements in kind, but more extensive work is required to overcome obsolescence as in this case it becomes necessary to strengthen and remodel the cars to overcome inherent weakness in design and construction. These cars remain a comparatively long time out of service and require a comparatively large expenditure to place them in proper condition. It is in the handling of heavy car repairs therefore, that the greatest opportunities exist to produce economies and reduce the time that the cars are held out of service.

Studies made of maintenance policies and work done in repairs over long periods, particularly in relation to the life of equipment, indicate that under conditions prevailing for the last thirty years, freight cars have been given heavy repairs by owners on an average of once every eight years. In other words, at the end of the eighth year the car, if normally maintained in the meantime so far as wearing parts are concerned, would require heavy repairs, which would again make is good for another cycle of about eight years, after which it would be again given heavy repairs for another eight years of service if found to be of proper design, or would run with a limit of repairs until worn out. In this case, the life would be extended to approximately twenty-four years or more, with a few years added to the life of the car where it was permitted to run in some minor service until entirely worn out. If, at the end of the second cycle, the car was found not worth repairing, it would be run about four years longer until worn out. In actual practice there is considerable variation of these figures so that studies have developed that the average life of equipment has been approximately twenty years, particularly the body, there being a factor of safety required in the trucks which made them serviceable for about five years longer than the body. Practically all freight cars in the country have been depreciated on the basis of a twenty year life for the body and twenty-five years for the trucks, as set up by the Interstate Commerce Commission for valuation purposes.

Frequency of heavy repairs

There is no specific record of the average frequency of rebuilding or heavy repair work by classes of cars. The general data indicates an average period between heavy repairs to box cars of about nine years for those equipped with modern steel underframes and about eight years for those with wooden underframes and relative construction. Modern refrigerator cars will require about seven years between heavy repairs because of the necessity of going over the insulating feature as well as overcoming structural deterioration. Stock cars will run about nine years

due to their light construction. Coal cars will run from nine to ten years whether all steel or composite. Steel floor sheets usually last about eight years and the side sheets about nine years, so that if false floors are used for a while, the cars can be run about nine years. This has been experienced with the character of metal used in the past, which has been unable to withstand sulphuric acid coming from the coal.

The wisdom of having freight cars in good condition cannot be doubted, and the expense of maintenance is justified, particularly where the general condition of equipment is such as to require heavy work to overcome what we might call inherent obsolescence. In other words, where the proper cycle of heavy repairs as previously explained, has not been maintained in due course, there develops a degree of deferred maintenance, and to a certain extent, obsolescence, which must be overcome sooner or later.

In order to maintain a normal situation as to design, construction and obsolescence, the average age of equipment should be carefully noted at all times, as this reflects whether or not old equipment is being retired as due, and replaced with new or rebuilt equipment. It has been customary to assume an average life of twenty years for freight cars. Assuming that a road has an ownership of 100,000 cars normally at all times, then from year to year it should retire or rebuild an average of 1/20 of 100,000 or 5,000 cars, and should acquire new equipment each year equal to the number actually retired and not replaced with rebuilt equipment.

It will be noted that a road has the choice of two policies in maintaining its equipment to overcome inherent weaknesses. It can retain its equipment for a longer period by overhauling and improving existing cars, or it can retire and replace the cars with new equipment at a more rapid rate. The policy to be followed depends upon many considerations, such as finance, operating expenses, and the extent of obsolescence.

Appropriations for freight car maintenance

The matter of appropriations for freight car maintenance deserves special study. Operating revenues have many mouths to feed and when heavy retrenchments in operating expenses become necessary it is to a certain extent inevitable that the maintenance departments bear more than their proportion of such retrenchments because maintenance work can be temporarily deferred without immediately destroying the effectiveness of the transportation machine. However, injudicious savings in maintenance results in actual loss to a road through increased transportation costs and, therefore, it should be determined where economy ends and loss starts in the retrenchment of maintenance expenses. An ideal condition would be to have the repair work equalized over the twelve months' period by arbitrary charges against income in the months of great business for credit and used during periods of revenue depression.

It is costly to make repairs to cars without proper repair facilities and equipment, and conditions become worse as the weight and capacity of cars increase. It is, of course, out of the question to provide numerous costly machines and tools where only a few cars are handled, but some repair tracks that turn out as many as 100 cars a day, have hardly no equipment for expediting the work.

The labor cost of repairs made on large repair tracks is usually much too high. Careful planning of major operations, and the judicious expenditure for facilities will do much to correct this condition. This problem again is a financial one and a road has the choice of three policies to pursue; first, resort to man-power due to inadequate facilities; second, add a few machines or tools each month so as to gradually reduce the repair expenses, and, third, spend a considerable sum immediately to equip the shops and repair tracks with the needed facilities. Obviously the policy to be pursued will depend upon the road's finances though no road can long afford to pursue the first policy for the lack of repair facilities decreases net earnings. Capital account expenditures cannot be made to better advantage at this time in any direction by the railroads than through provisions for modern repair shops and equipment. In the past the amount of money expended by the railroads for logical repair shop facilities has been lamentably out of proportion with the amount of money expended for cars and locomotives, resulting

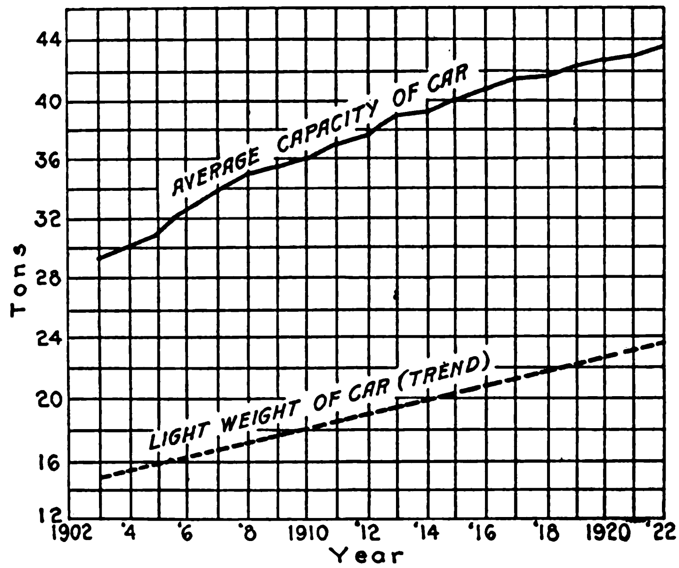


Fig. 3—Chart showing the increase in capacity and light weight of freight cars since 1902

in inadequate facilities for needed repair and modernizing work. The conclusion is that every advance in the art of car design should be met with a corresponding advance in the facilities for maintenance.

There is every reason to believe that the traffic on railroads in this country will increase as rapidly in the future as it has in the past, and that the locomotives and cars will continue to grow larger. Bigger power is demanded at all times and yet to haul a maximum train not only requires strengthening of freight cars, but roadways, bridges, engine houses, shop facilities and tools. It must be remembered, that when the freight cars are not used to the fullest degree they present a corresponding loss in all these elements, such as makes these extreme and uneven developments oftentimes show a poor net result.

Every freight car involves not only the cost of maintenance, but interest on the investment and current depreciating charges, both factors being higher because of increased investment cost. The object of the design of cars and the installation of facilities to make the maintenance cost relatively low, should be to increase the days of service by decreasing the days of detention in bad order because the greater present day cost of maintenance, interest and depreciation charges imposes upon proper railway management the requirement of greater availability for constant use.

In 1924 the Northern Pacific carried 3,607,987 revenue passengers. The average distance carried was 114 miles, and the average fare collected was $3.65. The company paid out in taxes that year $8,500,000. Therefore it required the entire gross amount received from the first 2,328,767 revenue passengers to pay the 1924 tax bill.

Air Brake Association Convention

THE following are abstracts or summaries of several papers, reports and discussions given at the thirty-second annual convention of the Air Brake Association. A brief account of the early proceedings of the opening session appeared on page 371 of the June *Railway Mechanical Engineer* and abstracts of a number of papers and reports were published on page 471 of the July issue, in which space was not available for the inclusion of those given here.

What are you specifying and getting in foundation rigging?

This report called attention to the common practice of assuming that if the piston travel (with the brakes applied) is of the proper amount and the brake shoes are of sufficient thickness to indicate lasting until the car reaches the next inspection point, or its destination, the car is in suitable condition to proceed as far as the brake conditions are concerned. Modern cars have, however, reached the stage where brake rigging is to a considerable extent hidden from view so that the time required for inspection for clearances and freedom from movable parts striking or binding, is well nigh prohibitive in trains en route, and is practicable only on the repair tracks or at lay-over points. It is therefore essential that all assurance possible be provided against such troubles by the design of the equipment and specifications to cover this design when the cars are built or reconstructed.

The report contained recommendations for the testing of air brakes on cars having both one and two brake cylinders and concluded with the following comment: "Improvement in car design seems to receive due attention in the way of applying all new features and developments that tend toward greater strength and wider ranges of utility until there is little room left on the cars for the proper installation of brakes. In view of the fact that brakes are first among the factors for safety and economy, it is suggested that when making up the design for cars it is highly consistent to provide ample room for the proper installation and operation of efficient brake equipment. This is equally important when getting up specifications for new cars or remodeling old equipment. The saving in cost of maintenance a few years later will have yielded large returns."

This report was contributed by the Northwest Air Brake Club through its committee, including Mark Purcell, Northern Pacific; James Elder, C. M. & St. P., and C. C. Ferguson, Great Northern.

Discussion

In discussing this report one member suggested that brake beam release springs are not always necessary and that half shoes be used in testing instead of removing the shoes entirely on one pair of wheels as recommended in the report. Mr. Purcell, in reply, pointed out that the removal of the shoes gives the maximum angularity of equalizers and indicates the probability of their striking parts of the car or truck and thus throwing all the braking duty on one pair of wheels, or two pairs in the case of a six-wheel truck.

To minimize the rapid wear of foundation brake gear and the development of slack it was suggested that the Committee on Recommended Practice establish a limit of at least 1/32 in. of case hardening on all brake rod and lever pins and bushings.

Report on recommended practice

The changes in practice recommended by this committee were accepted with a few exceptions. Paragraph A under air compressors was changed to read, *"Intermediate* valves should also be placed in the steam supply branch to each compressor so either can be stopped for any purpose." Throughout the entire report where the word "re-bored" was used in connection with cylinders, the words *"re-bored, or ground"* were substituted to comply with modern methods.

Under main reservoirs the association voted that a ½-in. drain cock *and Street ell* be located at the lowest point of each reservoir. Paragraph C under triple valves requiring that the ring opening positions be marked on the piston and the ring re-applied in the same position was referred back to the committee. Owing to the objections of some roads to the use of gasoline for cleaning triple valve parts and possibly creating a fire hazard, it was recommended that gasoline *or suitable cleaning compound* be used to clean all internal parts of the valves. Strong objection was made by some of the members to the use of any oil whatever in triple valves and consequently in Section K under triple valves the word *"graphite"* was substituted for "anti-friction oil."

Triple valve slide valve leakage indicator

In testing triple valves the leakage test provides that the exhaust port of the triple valve be coated with soapsuds to ascertain the amount of leakage when the slide valve is in emergency position and again when the slide valve is in release position. No limit is fixed as to the amount of leakage, so that the amount permissible is largely dependent upon the judgment of the individual test rack operator. Even if all individuals judged the amount of leakage uniformly there is a variation with the soapsuds that is independent of the operator. It has been found in testing a triple valve with one solution of soapsuds that the bubble will burst in five seconds, while another solution will hold a bubble for 18 seconds on the same valve. In addition, the temperature of the solution has a bearing upon how long the bubbles can be held.

A device lately developed, known as the triple valve slide valve leakage indicator corrects this situation and insures that all operators will judge slide valve leakage on the same basis which will permit positive condemning of triple valves when the leakage has passed a permissible value.

The principle of the slide valve leakage indicator is to cause the leakage from the slide valve passing into the triple valve exhaust to enter a chamber above a reservoir containing water. Pressure is therefore built up in this chamber which forces the water from the reservoir into a column adjacent thereto. It will be evident that the more the slide valve leaks the more rapidly will pressure be developed in the chamber above the water and the more quickly the water will rise in the water column. The rate at which the water rises in the water column is measured and this is taken as a basis for determining whether triple valves are in the proper condition.

The indicator is simple in construction but without a test code cannot be used. The following therefore covers

the test code to be used with this device. With the triple valve in the emergency position, time should be taken from the second to the third graduation and must not be less than the following: New—seven seconds; cleaned —five seconds.

In release position, the time should be taken from the second to the fourth graduations and must not be less than the following: New—ten seconds; cleaned—four seconds.

In the graduating valve tests, the time should be taken from the second to the third graduation and must not be less than the following: New—eleven seconds; cleaned —five seconds.

This report was submitted by the Manhattan Air Brake Club which is now conducting tests with the slide valve indicator, the results of which will probably be available for presentation before the convention next year.

Discussion

Several members spoke highly of this device and said that as a result of somewhat extensive use they considered it one of the most valuable adjuncts of the triple valve test rack that has been developed in recent years. The indicator is apparently not more liberal than the soap bubble test but assures a greater uniformity in the valves. In any event, reliance must be placed on the honesty of the operator since with the indicator he can permit air to leak past the rubber application end and thus give a false indication. The general feeling was, however, that the indicator will give highly accurate and uniform results.

Report on passenger train handling

In the main, this report was intended to clarify several points brought out in the report last year. After devoting some attention to the possibilities of graduated release and six different methods of making brake pipe reductions, the effect of pressure on triple valve movements was considered.

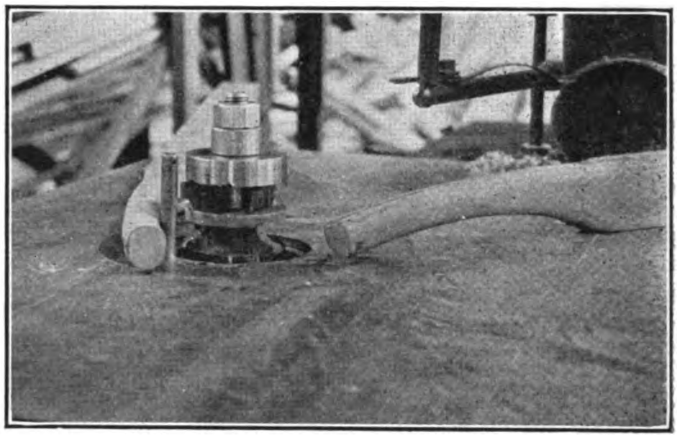
The report closed with a consideration of the relative advantages of the clasp brake as compared to the single shoe. These advantages were summarized as follows:

1.—Normal cylinder pressure per pound of brake pipe reduction.
2.—Shorter stops in emergency due to reduced brake shoe duty.
3.—Reduced brake shoe wear.
4.—Reduced brake shoe and truck maintenance.
5.—Less brake shoe dragging and reduced train resistances.
6.—Longer trains handled with less loss of time, using the same motive power equipment.
7.—Smoother stops.
8.—Fewer slid flat wheels due to shocks, stuck brakes and the transfer of load from one pair of wheels to another.
9.—Fewer hot journal bearings.

The report on passenger train handling was contributed this year by the Central Air Brake Club through its committee, consisting of James Elder, C. M. & St. P.; W. J. Devine, C. & N. W.; and L. M. Carlson, Westinghouse Air Brake Company

Device for forming handles on a wood shaper

THE usual method of forming the hand grips on wooden handles, such as used on hand trucks, is to mark out the general contour of the handles by means of a templet and then carve out the grips to shape by hand. This method requires considerable time and the finished handle is not as smooth as one turned out by the device shown in the illustration. It consists of two sets of forming tools separated by a collar. The two sets of tools, which are made from ordinary tool steel, are ground so as to form the finished contour of the handle.



Two sets of cutters quickly form the contour of the handle

The device is fastened on the spindle of a wood shaper. The handles are laid off to a templet and then quickly finished by the rapidly revolving cutters.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Wheels changed on account of owner's defect and the application of journal bearings within the thirty day period

On May 28, 1923, the Carolina, Clinchfield & Ohio applied to C. I. & L. car No. 18119, one pair of second-hand wheels and journals R. & L. No. 1, on account of a chipped rim on one wheel, the other being second hand. The old journal bearings were reapplied, as the billing repair card did not show the application of new bearings. On May 30, 1923, at a different point on the C. C. & O. system 136 miles from the point where the wheels were changed, one new solid 9-in. brass was applied to the same car at the R. No. 1 journal to replace a worn out brass. A charge of $2.06 was made against the C. I. & L. The car owner declined the charge for this journal bearing, contending that no charge should have been made for a subsequent application of a journal bearing when applied within 30 days of the initial application at the same journal location, on the same road and the same trip, as outlined in Rule 99, irrespective of whether the wheels were exchanged for owner's or delivering line defects. The C. C. & O. maintained that Rule 99 did not substantiate the claim of the car owner in that the brass removed and replaced at the time the wheels were changed on account of the owner's defects, does not constitute the initial application of the brass, and stated further that the repairing line had the privilege to decide whether or not there was sufficient service in the material to warrant renewing or replacing of the brass.

In rendering its decision, the Arbitration Committee

stated that: "The wheels were changed on account of owner's defects, and as only one journal bearing was charged within the 30 day period, the charge in this case against the owner is proper."—*Case No.* 1330, *Chicago, Indianapolis & Louisville vs. Carolina, Clinchfield & Ohio.*

Another case under Rule 32

T.A.R.X. car No. 25 was delivered by the Okmulgee Northern Railway to the plant of the Allied Refining Company on September 30, with two draft sills bent; one end sill broken; one end sill cover plate bent; one buffer casting broken; one pin lifter casting missing; one wrong draft gear Cardwell G-11-X, in place of a Miner friction gear; one wrong carrier iron; two wrong draft lugs; 18 lug bolts, which should have been rivets, and one common pin lifter which should have been full length. A defect card was demanded by the car owner in accordance with A. R. A. Rule No. 4, interpretation No. 1. The handling line refused to issue a defect card, claiming that the damages were not handling line defects, and contending that the defects were not caused by collision or impact other than that which occurred in regular switching, but by an ordinary draw bar failure, as there was no evidence that the car had been damaged due to any of the causes described in A. R. A. Rule 32. The car owner contended that the defect card should have been issued at the time of delivery according to A. R. A. Rule No. 4 which provides that the basis for responsibility should be placed according to the judgment of the receiving line under A. R. A. Rule 88. The car owner further contended that there was conclusive evidence to show that the damage to the draft gear was the result of unfair usage to the car.

In the decision the Arbitration Committee stated that: "The contention of the Okmulgee Northern Railway is sustained. The defects do not indicate delivering line responsibility. If the wrong repairs were not made by the Okmulgee Northern Railway it is not responsible for them."—*Case No.* 1329, *Okmulgee Northern Railway Company vs. Allied Refining Company.*

Proper application of temporary transverse tie rods

The Philadelphia & Reading presented bills to the Buffalo, Rochester & Pittsburgh for the application of temporary transverse tie rods to a number of B. R. & P. cars, during the months of February and March, 1923, according to Rule 21. The P. & R. stated that the temporary repairs were made because when the cars were delivered to its lines by the New York Central, in accordance with A. R. A. Rule No. 2, they exceeded its clearance limits on account of bulged sides. The temporary transverse tie rods were applied to put the cars in condition for safe movement over its line. Where the side sheets were worn or rusted, to such an extent that threaded rods could not be used, a clamp or hook end was necessary over the top angle. The P. & R. maintained that this application was proper and Rule 9 did not require the manner of application to be shown on the repair card. The car owner contended that from the manner in which the repairs were made that they were only temporary and were not chargeable against the car owner in accordance with Item *B*, Rule 21.

In rendering its decision, the Arbitration Committee stated that, "The application of transverse tie rods, according to Rule 107, Item 262, contemplates the use of rods properly secured with nuts, including necessary washers or plates at both ends. The application of the hook rods does not justify a charge against the car owner, it being considered as no repairs."—*Case No.* 1332, *Philadelphia & Reading vs. Buffalo, Rochester & Pittsburgh.*

Gondola car rebuilt in forty-five man-hours

D. & H. holds third repair contest—Three teams compete for silver cup and cash prizes

On Thursday, May 21, 1925, the car department of the Delaware & Hudson Company held the third of a series of car building contests at Carbondale, Pa. The problem on this occasion was the rebuilding of a Delaware & Hudson standard tandem twin-hopper bottom gondola car of 85,000 lb. capacity. The work consisted of assembling the trucks and rebuilding the steel underframe and wooden superstructure. Three teams of 16 men each, eight of which were wood workers and eight steel workers, competed. These teams represented the major car repair shops on the Saratoga, Susquehanna and Pennsylvania divisions, where work of this character is a routine performance.

The cars built in this contest are equipped with steel underframes and have wood flooring and super-structure, including the side stakes. The hoppers, with the exception of the side slope sheet are also of wood construction. An idea of the size and type of the car may be obtained from the illustration showing the car rebuilt by the winning team after it had been completed and placed in service. The distance over the striking castings is 38 ft. 1 in. and the distance between truck centers is 27 ft. 5½ in. The inside dimensions of the car body is 36 ft. by 8 ft. 6½ in., the distance from the top of the floor to the top of the side being 51¼ in. The large amount of wood construction performed upon the car was an excellent test for the wood working gang, which in the case of the Susquehanna division, which won the contest, completed its work in 25 man-hours; the steel workers completing their task in a little less than 17 man-hours.

The rebuilding of the car required the driving of 847 button-head rivets and the applying of 1,015 bolts of various sizes. The painting of the car required two gallons of red lead for the underframe, 3½ gallons of black paint for the truck and frame, three gallons of metallic freight car paint and one pound of white lead. The car is equipped with Wine hopper door appliances and side and end ladders, Miner draft side castings and Harvey draft springs. The trucks are of the archbar

type having cast steel truck bolsters and Schaeffer bottom connecting rods, brake hangers and truck levers.

The contest was started at 8 a. m. and continued uninterrupted, with the exception of an allowance of ten minutes after the completion of the steel work in order to make the necessary preparations for the wood work, until the car was completely built.

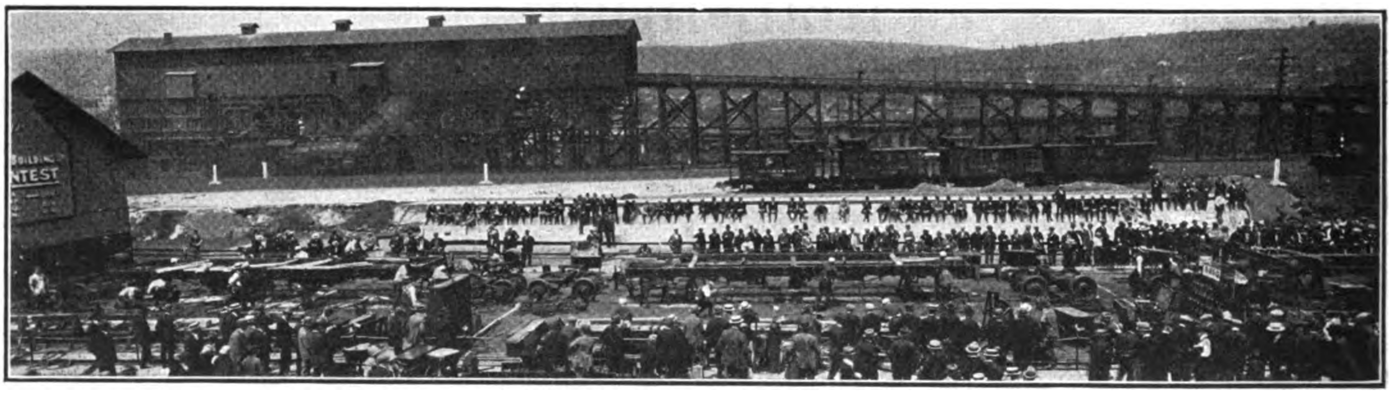
From the standpoint of the observer, the contest was of exceptional interest. No two of the three teams performed the work alike, or had the material arranged in the same manner. The team representing the Pennsylvania division assembled the underframe and then applied the draft gear and couplers. While this work was in progress, the work of rebuilding the trucks was completed. The next operation was to apply the steps, hand holds and uncoupling levers to the underframe, after which the car was turned over to the wood workers. This gang first applied the side sills, then the hoppers, floor and the ends and sides. After the various planks were placed in position for bolting, the trucks were run under the car and the work of applying and tightening the bolts on the woodwork, safety appliances, brake rigging, hand holds on the super-structure, etc., was completed.

Just before the start of the contest

The Susquehanna division assembled the underframe and applied the side sills, hoppers and floors in the order named. While this work was being completed, the trucks were assembled and made ready to place under the car. The next job performed was the application of the draft gear and couplers and the wood workers proceeded to apply the sides and ends, steps, hand holds and uncoupling levers. Upon completion of this work, the car was raised and the trucks run under, after which the work of applying the air brake apparatus and foundation brake rigging was completed.

The team which represented the Saratoga division applied the side sills as soon as the underframe was completed, finished the hoppers, applied the draft gear and couplers, and placed the trucks under the car, the trucks being assembled while the underframe was being built. The floors, steps and hand holds were applied at practically the same time as the air brake and foundation brake rigging. As soon as the uncoupling levers had been applied, each man on the team proceeded to tighten the nuts on the bolts and finish the various miscellaneous items.

The most noticeable variation in the steel work was that the teams from Colonie and Oneonta allowed the center sill channels to lie flange down on the horses until the center castings, splice plates and diaphragms had been secured. This appeared to be the best practice. The Carbondale workers, however, kept the channels on edge, making it necessary to steady them while the various operations were in progress. Another feature of the steel work which attracted considerable attention was a home-devised lever dolly bar used by a Colonie riveter which permitted him to hold a rivet and buck it up at the same time. Numerous other kinks and unique practices which were wholly permissible in the contest, were noticeable both on the steel work as well as that of the wooden super-structure.



Scene during the recent car building contest held by the Delaware & Hudson at Carbondale, Pa., May 21, 1925

The Colonie team was the first to conclude its steel work, finishing at 9:57 a. m. Oneonta was second at 10:05 a. m. and the Carbondale team was third, finishing at 10:50 a. m. In explanation of the wide divergence of time, particularly as between that of the Carbondale team

and the other two, an agreement was made between the three divisional car foremen prior to the contest which permitted them to assign the truck work either to the steel crew or to the woodworkers. Of course, in actual practice, truck repairers will do this work but these men

Presentation of the Birkett silver cup

were omitted from the teams as were the air brake men and painters. Carbondale chose to have its steel men assemble the trucks and this plan would have worked very well but for difficulties encountered in the work of assembling. It was thought that this arrangement would effect better equalization of the men on the team for when certain men were no longer needed on the steel work, they could be used on the trucks. The Oneonta and Colonie teams left the trucks to be assembled by the woodworkers.

Differences in practices among the woodworkers were also noticed by the manner in which they handled the side sills. It was generally agreed that the Colonie team used the best method: namely, that of allowing the sills to lie flat on the horses until the stake pockets had been secured by U bolts, after which the sills were turned over and the nuts run down with an air machine. Portable scaffolding appeared to be an advantage to the Oneonta team as compared with the ladders used by its competitors when bolting the side stakes, corner bands, securing the Wine ladders and other outside appliances.

The Susquehanna division team was the first to complete the task, which required 5 hr. 20 min., making a total of 42⅔ man-hours, exclusive of the air brake work, painting and stencilling. Adding this work to the total man-hours required to build the car, the entire job of rebuilding, painting and stencilling the car required a total of 45⅓ man-hours. The time required for this team to perform the various major operations was as follows:

	Man-hours
Trucks completed	1 hr.
Steel work	16 hr. 40 min.
Wood work	25 hr.
Air brakes	1 hr. 10 min.
Painting and stenciling	1 hr. 30 min.
Total	45 hr. 20 min.

At 4 p. m., approximately one hour after the Susquehanna division had completed its work, the first car was spotted and loaded at the coal breakers at Carbondale and left that point 55 min. later, destined to Wakefield, Mass., via the Boston & Maine.

The judges were P. Alquist, master car builder, Delaware, Lackawanna & Western; W. G. Knight, mechanical superintendent, Bangor & Aroostook, and C. P. Pfeiffer, master car builder, Buffalo, Rochester & Pittsburgh. This committee inspected each car upon the completion of each major operation and also made a

The winners—Susquehanna division team

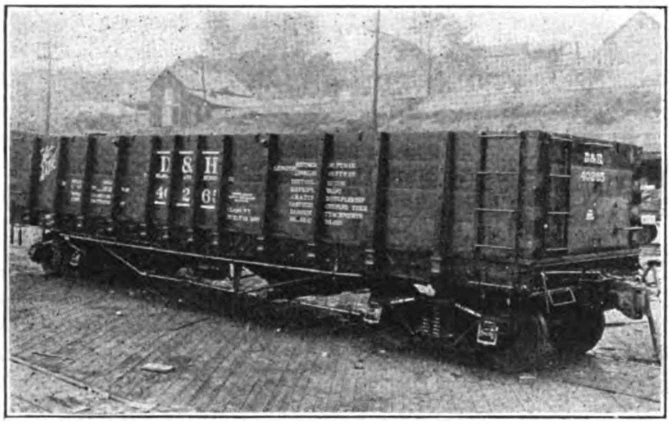
Seated (left to right): Alex. Ushtwant, Henry Neilson, Horace Landry, Fortunatus Kattansick, Percy Brush and Fred Lamb. Second row: John Knosvitch, Joseph Dilello, Lee Coburn, Warner C. Arndt, Albert Dilello and Fred Demesko. Standing: Claude E. Gregory, piecework inspector; Ross J. Comstock, foreman steel gang; Egnu Solowich, Daniel Patrick, Herman Wells, Louis Colone, Mike Truchan, Elmer Young and Rathbun J. Cook, foreman wood gang.

final inspection after the work was completed. It reported that in its opinion, the work of each team was of an equally high standard so that the status of each was fixed by the time required to complete the work. The prizes were awarded by Colonel J. T. Loree, vice-president and general manager, Delaware & Hudson, who was an interested spectator throughout the contest and complimented the winners on their excellent performance which won them the contest.

Approximately 500 persons witnessed the contest and the awarding of the Birkett silver cup to the Susquehanna division team for the second consecutive time. This cup is dedicated to the memory of the first foreman of the car department of the Delaware & Hudson. In addition to the cup award, each man on the winning team received a cash prize and a further cash prize was awarded to the Saratoga division team, which took second place.

Representatives of 23 railroads and 34 railway supply companies, as well as two inspectors from the Interstate Commerce Commission, were registered in attendance at the contest. A box lunch, prepared by the wives of the supervisors of the car department of the Pennsylvania division was served in the wood mill during the noon-hour to the guests of the Delaware & Hudson.

These contests, of which this was the third, are entered



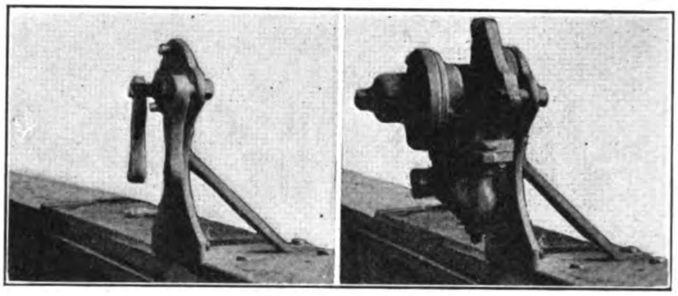
Car built by the winning team ready for service

into with a friendly spirit of rivalry and are not only interesting, but also instructive to the employees. One of the outstanding features is the material layout, which indicates in many respects efficient and economic car shop operation. The compensation of the employees in the car department is fixed on a piece-work basis and these contests afford an ideal opportunity to study that phase of car repair work. The ready accessibility of material stimulates production and the resultant increased output is reflected in the earnings of those on a piece-work basis.

The first of these contests, which was described in the January issue of the *Railway Mechanical Engineer*, was held at the Colonie shops on October 31, 1923. Five teams of six men each, selected from the major shops of the Delaware & Hudson participated, the winner of that contest being the Carbondale team which completed the task in 7 hr. 49 min. The second contest was held at the Oneonta shops of the Susquehanna division on May 8, 1924, at which time the super-structure of a 60,000-lb. capacity steel-frame box car was rebuilt and the trucks and draft gears assembled. Three teams of eight men each competed. The winner was the Susquehanna division team which performed the work in 6 hr. 30 min., or 52 man-hours.

A handy device for holding triple valves

A DEVICE for holding triple valves while they are being repaired is shown in the illustration. It is made of ¾-in. steel plate bent to 90 deg. and braced as shown. The working face of the holder is provided with two pins that fit snugly into the upper and lower bolt holes of the triple valve and two locking handles having inside



Left—Holder ready to receive triple valve; Right—Triple valve in position

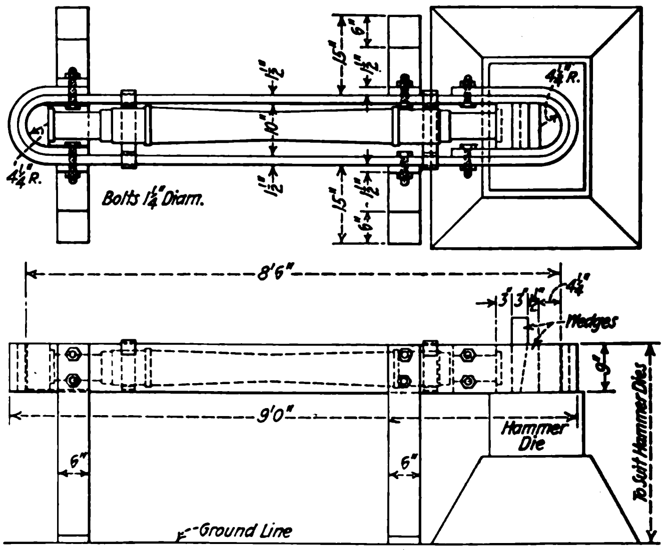
cam surfaces. The triple valve is placed on the holder by inserting the pins through the bolt holes and turning the locking handles upward. The cam surfaces serve as a wedge to hold the triple valve securely against the working face of the holder.

Tool for upsetting car axles

By F. L. Clark

Blacksmith foreman, Southern Pacific, Algiers, La.

THE reclamation of worn car axles is a perplexing problem which most all car departments have to contend with and many tools have been devised for upsetting car axles which have been more or less of a success. The tool shown in the illustration is simple in



Method of holding the axle during the drawing out and upsetting operations

construction, easy to handle and gives very good results.

The axle is first drawn out to length and then straightened in a centering machine to make it run true. Each end of the axle is then heated and upset so as to obtain

sufficient stock to make the collar after which the journal is turned on a lathe to make a new fit.

It can be seen from the following table that the axles are reclaimed until they are down past the lowest limit.

Size	Capacity in lb.	Amount center is drawn out	New size	Capacity in lb.
5½ in. by 10 in.	100,000	1¾ in.	5 in. by 9 in.	80,000
5 in. by 9 in.	80,000	1⅝ in.	4¼ in. by 8 in.	60,000
4¼ in. by 8 in.	60,000	1½ in.	3¾ in. by 7 in.	40,000

With this tool the center is drawn, each end upset and the journal turned for a new fit for $7.35 which includes labor and material, charging the axle at scrap price. Forty-five axles—90 ends— are upset in 7 hr., 20 min., which includes the trucking time to and from the shop.

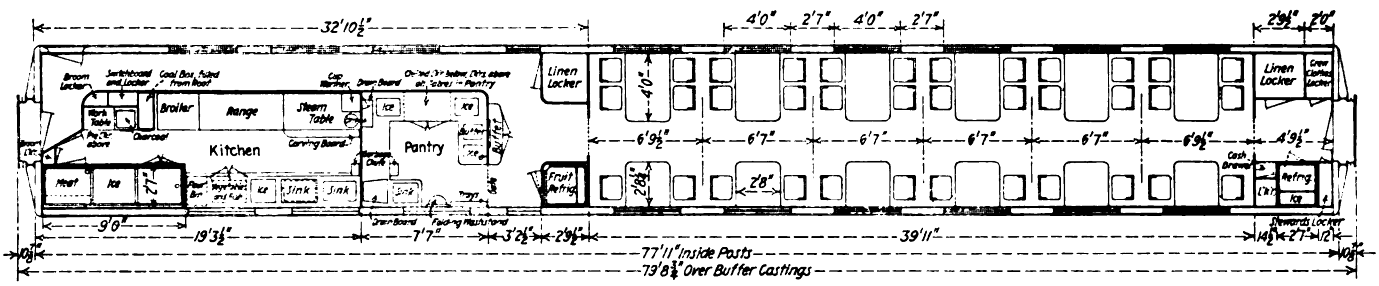
St. Paul to rebuild dining cars

THE Chicago, Milwaukee & St. Paul contemplates rebuilding its wooden dining cars with seating capacity for 30 guests, into 36 seat, steel underframe diners, and the first sample car was recently completed at the railroad company's shops, Milwaukee, Wis.

greater working room, as well as to provide locker space to make the car suitable for Coast line service. The practice on the C. M. & St. P. is to stock dining cars in Coast line trains at Chicago and Tacoma, Wash., the two terminals, and it is, therefore, necessary to take provisions for a 75-hour run. For this reason, an unusually large refrigerator is provided.

It will be noted that the refrigerator compartment near the end of the car has space for meat hooks, so that entire sides of beef can be placed in this compartment. The refrigerator is of the modern type, being iced from the roof. Other features in the kitchen and pantry are indicated on the floor plan.

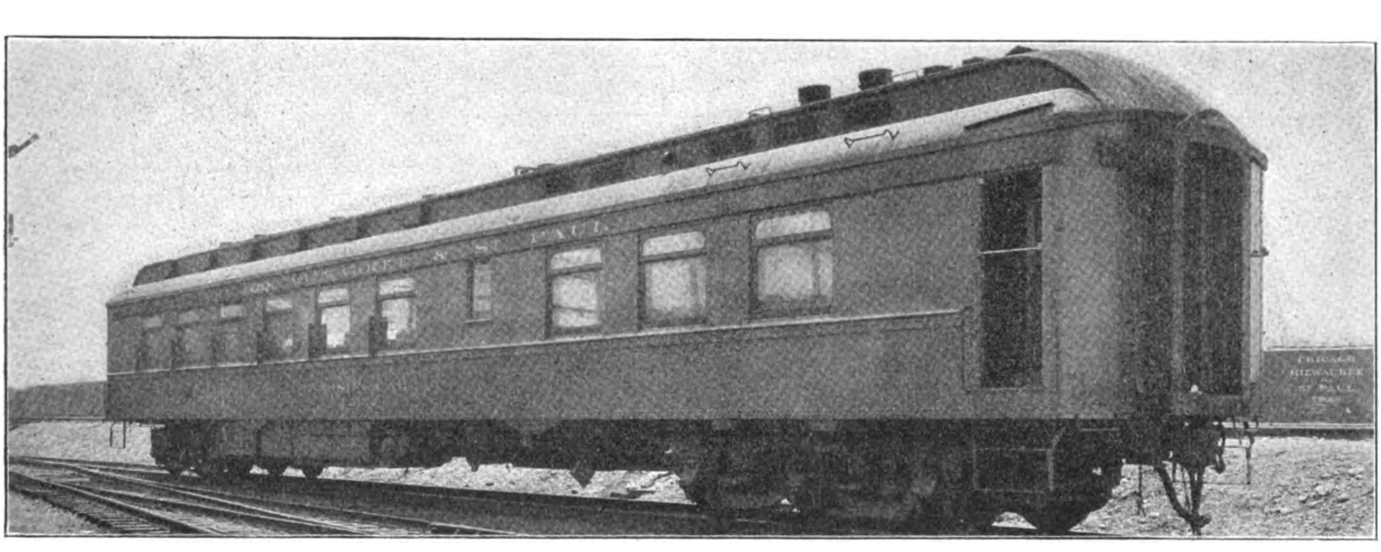
From the illustrations it will be noted that the usual standard depth of underframe is employed. In order to make provision for such an underframe, it was necessary to replace the wooden center sills with stringers and bring the steel underframe up close to the floor in order to obtain the usual clearance from top of rail to bottom of center sill. The object of making the sill of standard depth was to obtain an underframe together with the side sill construction of adequate strength to carry the



Floor plan of rebuilt C. M. & St. P. diner—Six additional seats in the dining room and unusually large kitchen space are provided

The rebuilt car is equipped with a steel platform and steel side girders of adequate strength to carry the weight of the car, equipment and passengers without the use of truss rods. The original car was of the ordinary vestibule type and in order to provide two additional tables

weight of the car body and equipment without maintaining the truss rods, originally under the wooden cars. A center sill of less depth than 26 in. in this case proved to be unsatisfactory from an engineering standpoint, when buffing stresses and direct leads were considered.



C. M. & St. P. diner recently rebuilt at Milwaukee shops—Steel underframe applied—Seating capacity increased

the end bulkheads of the car were moved out to the buffer beams, eliminating the side doors with the exception of one door at the kitchen end.

The arrangement in the kitchen and pantry is new, as additional space had to be provided in order to obtain

It will be noted that the center sills project 5¼ in. above the top surface of the cast steel double body bolster and platform casting. The reason for this offset is to avoid as far as possible alterations in the present wooden underframe, as with this construction it is only neces-

sary to remove the wooden center sills at the distance equal to the length of the steel underframe, leaving the platform intact. It will be noted that the platform casting is of the vestibule type, this arrangement permitting the

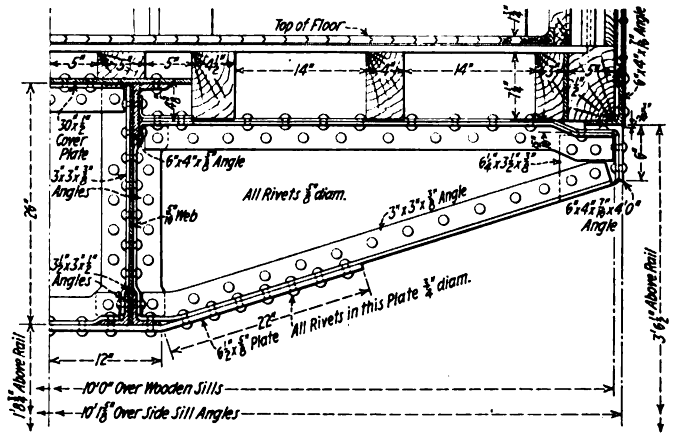
The interior view of the car creates an impression both of simplicity and of beauty

use of a standard underframe construction for both vestibule and blind end cars.

Interior finish and decoration

It will be noted that the contour and ceiling decoration is a departure from present practice, inasmuch as practically all moulding has been eliminated. The ceiling consists of a three-ply veneer covered on the underside with a ed. The ceiling lamps as well as the base of the ceiling fans have special ornamentations to match the side fixtures.

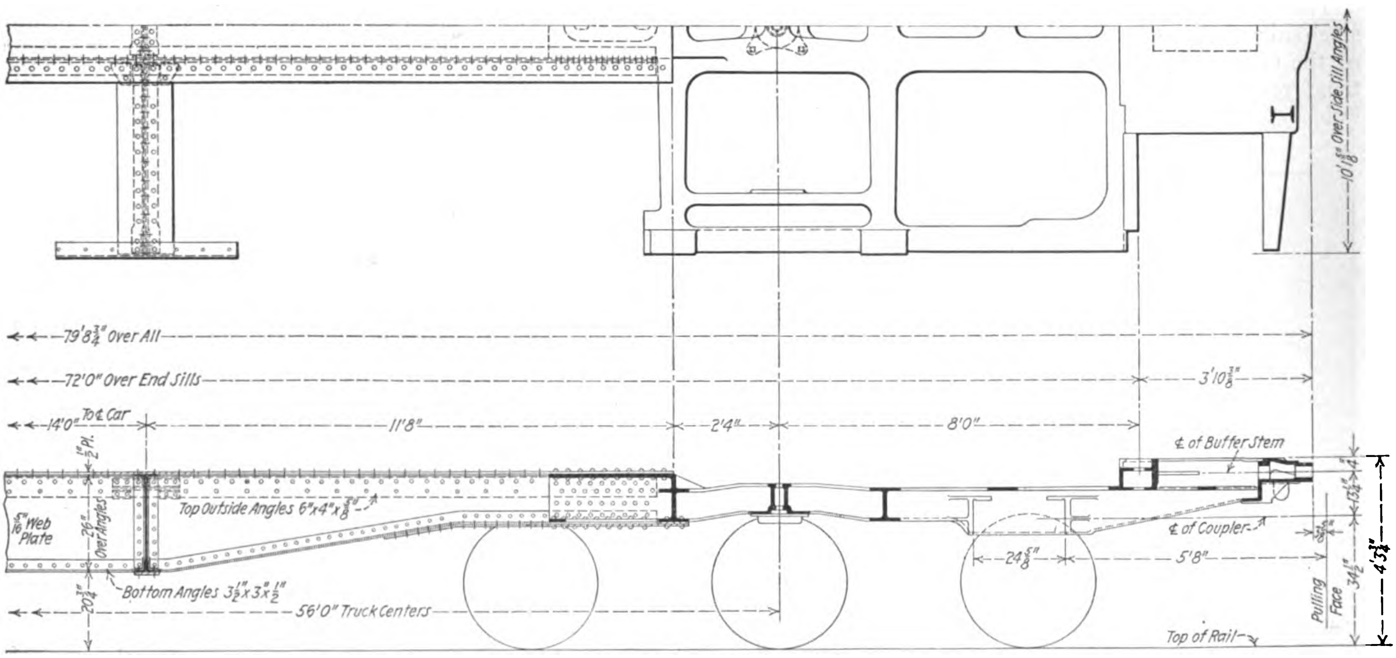
From the interior view it will be noted that the buffet is built to a height as used in dwellings. This was made



Cross-section showing arrangement necessary to accommodate the increased depth of center sill

to obtain a homelike appearance in the car. In place of the ordinary decksash, it will be noted that shutters in the form of grills are introduced in the upper deck.

Prizes of $25, $20, $15 and $10, and six prizes of $5 each are being offered by the general loss and damage prevention committee of the New York Central for the best articles containing practical suggestions for the reduction of loss and damage to perishable freight. The prizes are offered in connection with a campaign now being conducted by this road,

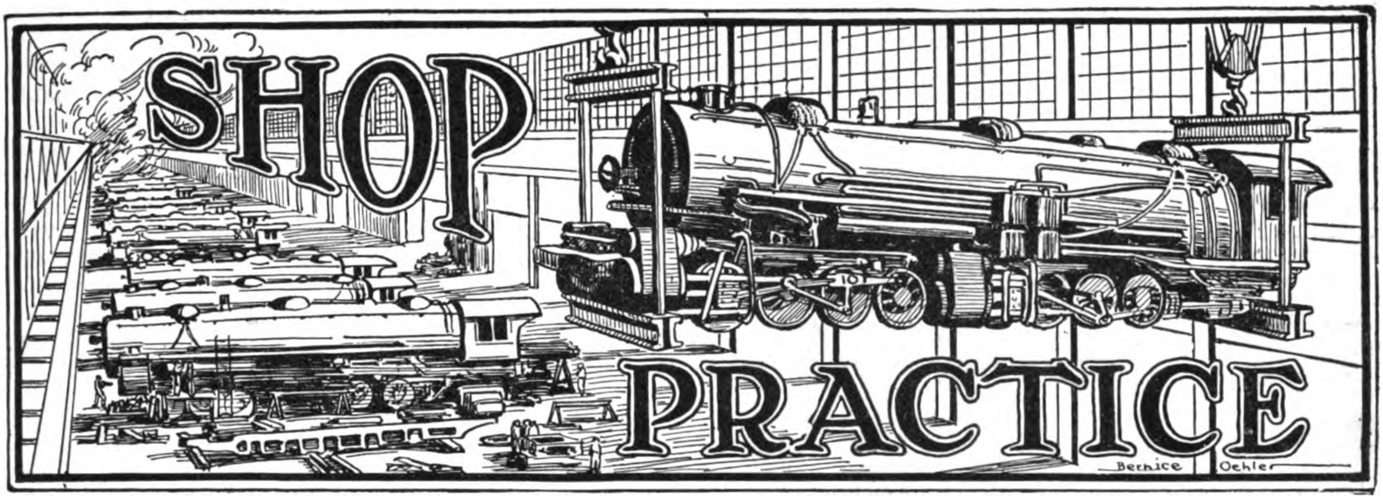


General arrangement of center sill and platform casting—Standard depth, 26 in. sill used

heavy burlap, the painting being light cream, stippled. The side finish is plain Cuban mahogany without any inlay or ornamentations.

The chairs are upholstered in black leather to match the carpet, which has a black background with a floral pattern in Chinese red. The side lights are especially designed for this car, with parchment shades, hand paint-

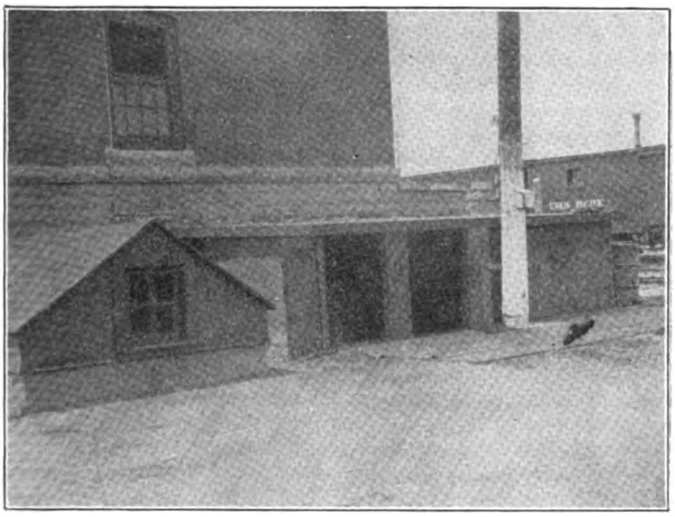
as a means of further reducing damage to perishable freight. The contest is open to all employees of the New York Central except agents at Class A, AB, B and C stations, general yardmasters and assistant general yardmasters, and supervisory officers of other departments occupying positions of similar rank. The papers submitted must contain not less than 500 words and not more than 1,000. The contest ends on August 31.



Handling locomotive supplies

Judicious location of the building containing supplies saves time, labor and material

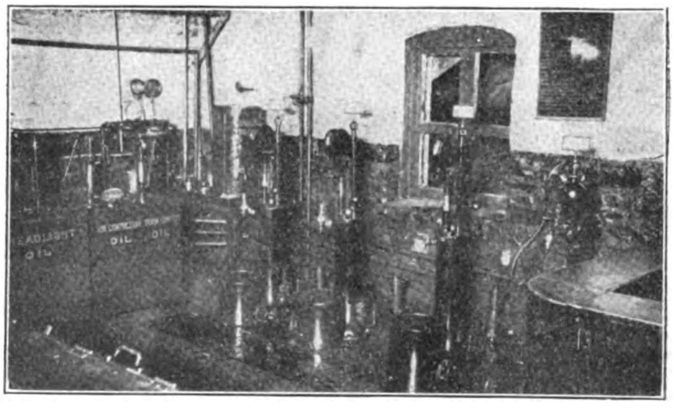
THE overall efficiency of an enginehouse in turning locomotives is dependent on the efficiency with which individual maintenance and servicing operations are performed, and one of these operations involving a magnitude of expense not always appreciated is handling engine supplies. The problem of efficiently supplying oil and other materials to engines was studied at the Union Pacific enginehouse, Cheyenne, Wyo., and a method developed which, having proved its merit, may be of suggestive value to other railroads.



Fifty-gallon oil barrels on two-wheel trucks are run into this shed from which they drain to the oil storage tanks in the supply house basement—The shed is air tight and heated in winter

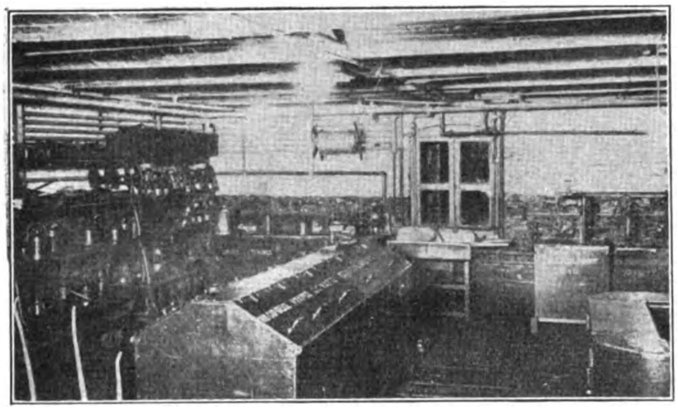
The method formerly in force at Cheyenne was to bring each day's supply of oil and materials needed for the engines from the general storehouse, located comparatively near the enginehouse but still too far away to be a convenient base of supplies. Time was lost going to and from the storehouse and it was impossible to maintain an accurate control of the materials issued. The brick building, shown in the illustrations and formerly used for waste reclamation and storage, was therefore converted into a supply house for engine oil and other materials. Being located adjacent to both the inbound and outbound tracks, it forms a convenient base for engine supplies which can be handled with much less labor than formerly. Material is saved and the entire operation of handling engine supplies is brought under the closer supervision of the enginehouse foreman with a resultant increase in effectiveness and economy.

During times of peak load 100 locomotives are handled at Cheyenne in 24 hours and by means of the new supply house conveniently located and fully equipped, it has been possible to reduce the number of men engaged in handling engine supplies to one man on each of three shifts, with a laborer on the day shift. When an engine comes to the enginehouse, the light supplies are taken off by the supply man, assisted by the hostler. When the engine is ready to be dispatched the supply man takes out valve oil, car oil, fusees, torpedoes and flags. Since the Union



Interior view of the engine supply room showing Wayne oil pumps—Lubricators are drained and the oil strained for re-use

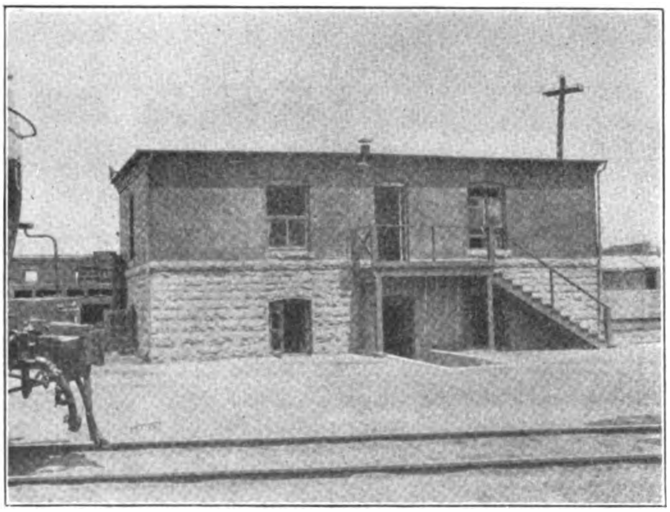
Pacific locomotives are practically all in pooled service, each locomotive carries its individual set of tools which are locked in an ingenious holding device on the front of the tender. These tools, therefore, are seldom lost, and need not be renewed except in case of breakage. The supply man also brings out to the locomotive lanterns, waste and a torch and checks the engine for the heavy supplies, including rerailers, switch chains, clinker hook, spout hook, shaker lever and knuckles. The supply man



Orderliness features the engine supply house, a place being provided for everything and everything being kept in its place—The sectional waste container is shown in the foreground

watches the dispatcher's board to see that outgoing engines are furnished with supplies in ample time to avoid delay.

The engine supplies are kept in the basement of the building, the other floor being occupied by two offices. Access to the supply room is readily had through the basement door shown in one of the illustrations. The arrangement of the interior is also clearly shown in the illustrations. Oil is furnished by means of four Wayne oil



Engine supply house reconstructed from waste reclamation and storage building at the Cheyenne enginehouse of the Union Pacific

pumps which draw from storage tanks beneath the basement floor. Oil is moved to the supply house in 50-gal. barrels on 2-wheel trucks which are run into a practically air tight shed built at one end of the supply house and piped to the storage tanks below the pumps. In winter the doors of this shed can be closed tight and, by means of steam coils on the inside, the temperature kept at a point where the oil will flow freely from the barrels to the storage tanks.

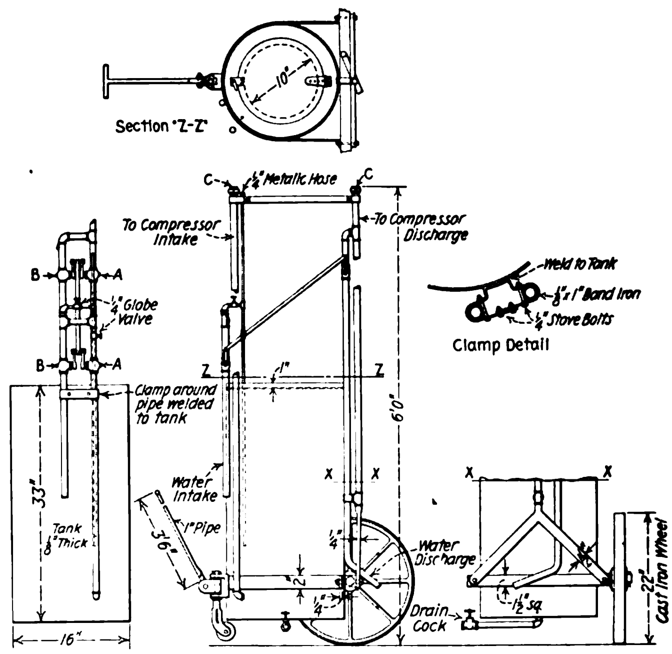
The engine supply house is kept very neat and orderly with a place provided for every item. Lanterns and torches are cleaned at the bench adjacent to the lantern storage rack. Lubricators are drained and the oil strained and re-used in order to eliminate as far as possible all waste of oil which represents just so many dollars and cents. Cellar grease is reclaimed by the regular supply men in their spare time. The grease as received at the supply house in barrels is picked over by hand to remove the dirt. It is then formed in cakes of specified standard sizes by means of dies in a pneumatic press. Thin cakes are built up to standard thickness by adding layers of the required thickness at the bottoms.

The experience of the Union Pacific with this carefully laid out and operated engine supply house indicates that the time and effort expended on it are well worth while. It makes possible considerable savings over the more common type in which the attempt is made to keep engine supplies in an old box car body, having neither room, light, nor facilities for handling any considerable amount of material.

Air compressor laundering equipment

ONE of the subjects discussed at a recent meeting of the Manhattan Air Brake Club was the method for laundering air compressors. Among the various devices proposed as giving excellent results was one used on the New York Central Lines East.

The laundering machine consists essentially of a tank



Drawing showing the construction of the air compressor laundering device

mounted on wheels and equipped with the necessary pipe and hose connections. Referring to the drawing, connections are provided to the compressor intake and discharge by means of six-foot lengths of ¾-in. metallic hose with suitable pipe fittings on either end. When circulating potash through the compressor, the cocks *A* are opened and the cocks *B* closed. When it is desired to circulate clear water through the compressor, the cocks

A are closed and the cocks *B* are opened. All pipe and fittings are ¾ in. with the exception of the steam line which is ¼ in.

The solution tank is 33 in high and 16 in. in diameter and is made of ⅛-in. steel plate. The top head is provided with an opening 10 in. in diameter which is sufficiently large for large pieces of potash to be dropped into the tank. This eliminates the necessity of having to break the potash into small pieces which is an unpleasant job, because the dust gets into the eyes of the workmen. This arrangment also eliminates the necessity of having to melt the potash into a solution before it is placed in the tank. The opening on the top of the tank is provided with a cover to prevent the solution from being splashed out on the workmen when engaged in starting the air compressor or moving the tank about the enginehouse.

The solution is kept hot by a steam connection to the compressor drain cock. Thus a connection to the shop steam line is not required. A tank of this capacity permits one charging of the solution to be used a number of times. Owing to the size of the top opening, the laundering machine may be used for cleaning parts other than the air compressor, such as feed valves, pump governors, etc.

A duel circulating system is provided for both solution and clear water. It will be noted from the drawing that the circulating pipe system is arranged in such a manner as to prevent water from getting into the solution and diluting it. A fresh water connection on the equipment affords a quicker way of circulating clear water through the air compressor than is possible when the laundering device has to be disconnected, the compressor shut off and a water connection then made at the compressor. In other words, when this device is connected to the air compressor and started, there is no need to make any further adjustments, except to turn cocks *A* and *B*, until the job of cleaning is completed.

The design of the laundering machine is such that the weight is reduced to a minimum and is balanced around the axle which permits easy handling by the workman. The wheels are 22 in. in diameter which allows the machine to be hauled readily over rails or small obstructions on the floor.

Master Blacksmiths meet at Cleveland

Many new methods are proposed and discussed—Development of welding has reduced blacksmith shop costs

THE International Railroad Master Blacksmiths' Association held its twenty-ninth annual convention at the Hotel Winton, Cleveland, Ohio, August 18-20, 1925. There were over 110 members in attendance. Two factors stood out prominently in the discussion of all of the reports, namely, the effect that the rapid development of welding has had on blacksmith shop work and the need of having proper and adequate machine tools and shop equipment. This latter factor was emphasized by trips to the plants of the Acme Machinery Company, the Ajax Manufacturing Company and the second machine tool exposition of the National Machinery Company, Tiffin, Ohio.

It was decided to hold the 1926 convention at Cleveland. The following officers were elected for the ensuing year: President, H. W. Loughridge, P. & L. E., McKees Rocks, Pa.; first vice-president, L. C. H. Weideman, C. C. C. & St. L., Beach Grove, Ind.; second vice-president, W. W. Shackford, A. C. L., Waycross, Ga.; secretary, W. J. Mayer, M. C., Detroit, Mich. Abstracts of a number of papers which were presented at this convention follow:

Jas. J. Egan (N. Y. N. H. & H.)
President

H. W. Loughridge (P. & L. E.)
First Vice-President

W. J. Mayer (M. C.)
Secretary and Treasurer

Autogenous welding

Two papers on autogenous welding were presented by E. M. Turner, A. C. L., Rocky Mount, N. C., and C. K. Abbott, L. S. W., Tyler, Texas. Autogenous welding has come into shop practice so rapidly and has

speeded up shop efficiency to such an extent that we find ourselves asking the questions: How did we get along before we had it, and what would we do now without it? Autogenous welding has probably saved the railroads more money and time in the repair and upkeep of worn and broken parts, especially that of locomotive frames, than any one process ever introduced into the railroad shop. In addition, many intricate forgings can now be made on short notice and with less expense.

It was generally conceded that both the acetylene and the electric methods each had its place and that one had advantages over the other on certain jobs. In some shops it is the practice to require all welders to make a test weld every three months and the men making the best test are the men put on the best class of work. In many shops practically all of the boiler welding is done with the electric method, as well as link motion work, while frames and cylinders are welded with oxy-acetylene with good success.

One speaker said that his road used both methods at the reclamation plant. Each job of welding and cutting is followed up by a competent welding supervisor who is requested to keep a close check on the cost of the different operations.

There was also considerable discussion as to the relative merits of thermit and oxy-acetylene welding for repairing locomotive frames. It seemed to be quite generally agreed that thermit produced better results around the pedestal jaws, but considerable pains should be taken to properly preheat the frame and also to retain the heat around the "V." The use of asbestos lagging is now recommended as satisfactory for this purpose. Allowance should also be made for expansion in both the upper and lower rails of the frame. In case the fracture is in the top rail, the lower rail should be cut to permit equal expansion. One of the speakers also recommended heating the frame on the opposite side of the locomotive and then annealing the welded portion so that both sides would be alike.

The development of the otheograph for cutting out parts of locomotive frames, chains, hooks, etc., was also commented on. Cutting out parts by this method has effected a considerable saving over the old methods of forging. In cutting iron by the use of the torch, it is not necessary to preheat, but steel should be preheated and annealed afterwards.

Carbon and high speed steel

By J. H. Hill

Blacksmith foreman, Chicago, Burlington & Quincy, Aurora, Ill.

The tool temperer should be provided with facilities to closely duplicate the different hardening and drawing heats required by various classes of tools. Compare a forge fire, radiating heat from one direction, the heating of one tool at a time and a tool temperer's eye as the best gage, to a properly constructed furnace heating slowly and evenly a number of pieces in the same time and the correct heat ascertained by a pyrometer. It can be seen that such facilities are necessary to economical and efficient duplication of the tool temperer's work.

Our products are charged with the expense and we are held accountable for the results of these tools. It thus behooves us to become informed on modern tempering equipment so we can make recommendations and use our influence to get these facilities.

Keeping the tool temperer informed as to the results of service obtained from the tools is necessary to attain high efficiency for the most modern equipment. It is in no way a self-operating device, but it will, with the co-operation of the tool foreman and the tool temperer's knowledge, give the results for which we aim.

The hardening or refining heat is of the most importance, for it is the base and a one hundred per cent tool can not be produced unless this part of the work is done correctly. There are three different methods used in ascertaining the correct hardening heat, all of which are good, and in a measure depend upon the mechanical equipment. If the furnace is equipped with a pyrometer, reduce the heat of the furnace below the hardening heat. Place the pieces in the furnace and have the thermo couple arranged so that the slightest change in the heat of the piece will instantly show on the pyrometer. Then set the regulators so that the heat is slowly advanced and when the hardening heat is reached a slight pause is noted on the pyrometer which indicates the hardening heat. Small furnaces are manufactured which are sensitive enough for this particular work.

The second method is the magnet and it is used in the following manner. Couple the magnet to a light socket or to a battery system. The magnet is balanced on a rod so that the back end is slightly heavier than the front end or magnetic point. Reduce the heat of the furnace below the hardening point. Place the piece in the furnace and set the regulators so as to obtain a slow rising heat. Then apply the magnetic point to the piece being heated. When the heat gets close to the correct hardening heat, the piece will cease to attract the magnet and the slightly heavier back end will cause it to change position, which is a notification to the operator that the hardening heat has been reached.

The third method is one that has been used for many years and is as reliable today as it ever was and is as follows. Turn a test piece one inch round and about three inches long. Then nick on one side and temper at the lowest heat which will make the piece file proof. Fracture and examine the grain which will, with practice, enable the tool dresser to determine if it has received the correct heat. It will further enable him to pass judgment on a tool that has broken in service and if the grain is right, prove that some other than incorrect hardening is the cause and thereby save breakage of future tools used for that particular purpose. The correct time required for heating has been worked out in several ways and the following general system gives the best results: The correct hardening heat of a tool, we will say, is about 1500 deg. F. The regulator of the furnace is set to maintain that heat. Then lay the tool on the floor of the furnace and move it every few minutes, noting if the spot on which it was lying is darker than the rest of the floor. If the floor is darker, the tool is not heated through, but if the spot shows the same color as the rest of the surface, it is heated through. It should be left to soak five minutes to each inch of thickness after the spot on the floor is gone.

Drawing the temper of tools made of carbon or high speed steel is done to relieve them of hardening strains, which are set up throughout the tool. The drawing heat, to be efficient, must be through the entire piece so that the core as well as the outside wall is benefited. This is also a point to be considered in examining fractures.

An epidemic of breakage occurred in the fillet of the shank of beading tools. Examination of the fracture of the tool showed the core to be file proof. The outside surface, however, could be readily touched by the file. This proved beyond doubt that the tools had been overheated in tempering and a quick drawing heat had been produced. The color on the surface had not

benefited the core. As a result we always check the drawing heat in oil.

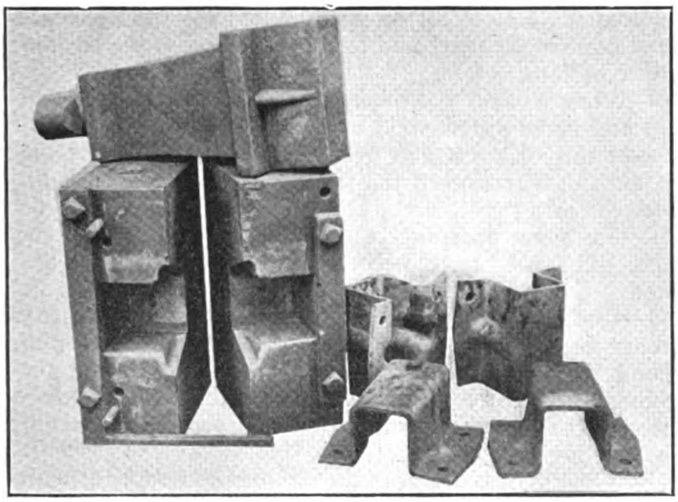
One other point on the drawing of temper that we endeavor to make is to draw at the lowest heat which will satisfactorily answer our purpose, for the lower the drawing heat the harder the tool. It is the rule rather than the exception, that the harder tool will give the best results.

We have handled a large amount of carbon and high speed steels and most always get good results by following the instructions given us by the steel men. In 1919, when it was hard to get tool steel, our tool room foreman had 12 sets of dies and punches to make for forming copper ferrules for flues. These dies had to be gotten out in a hurry and as we had no tool steel from which to make them, we made them out of scrap pieces of Nychrome steel side rods. These punches and dies when properly heat treated have made thousands of copper ferrules in the past six years and are still in good shape.

Drop forging

By F. P. Deissler
Blacksmith foreman, Bessemer & Lake Erie, Greenville, Pa.

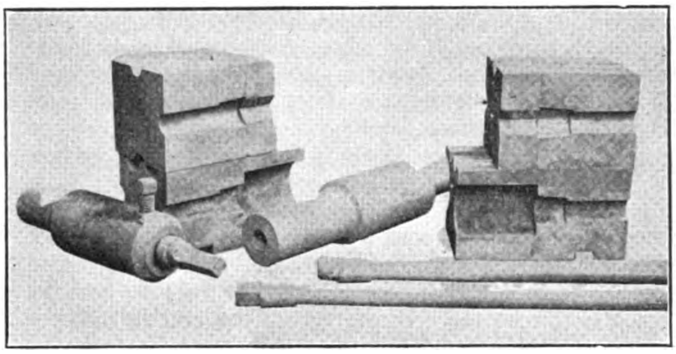
Concerns that have made a business of drop forging are, of course, better equipped with machinery and capable men to work out their dies. This is important, for if your dies are not right, you cannot get the required results. The average railroad blacksmith shop does not have drop hammers because of not having enough work to justify the installation of such a tool, but practically all have steam or power hammers of some description, or at least should have. We do considerable work that we call drop forging in our shop, but we use the pocket die method and get fair results. The dies used are not expensive and doubtless the results obtained are as good as can be done without a drop hammer.



Dies for forming stake pockets

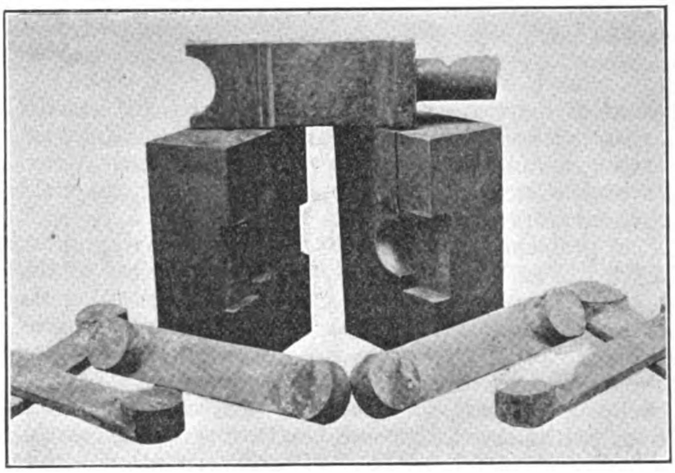
We make our own dies in the blacksmith shop, except shaping the edges and drilling. We first make a master piece of the article we want, taking a little care to get it as nearly the exact shape as possible, except in thickness which we make 3/8 in., or more, too large. We then forge two pieces of steel so as to have at least 1 1/2 in. thickness at the bottom of the impressions and enough larger than the impression so as to have at least 2 in. on all the edges. We then reheat to a good soft heat, clean all the scale from the faces and place the master piece between these two blocks and press or drive them under the hammer until the edges come close. We then take them to the machine shop and have the faces planed off so the impression will be the correct depth in each, the master piece being thicker than the finished piece.

This brings the edges of the impression to a good edge; otherwise they would draw in and leave too much opening at the edges. We then have them planed to a given size on the outer edges, placing a finished piece between so as to be sure that the impression and outside edges are correct. We then make a band, the size of the blocks and about 2 in. higher than the bottom one, so as to receive the top block which should be loose enough so as to enter freely and guide it to the proper position. The impressions should have about 1/16 in. chipped back about 1/2 in. or 3/4 in. for splash.



Dies and headers for forming taper crown bolts

For work which is done from the end of the bar, a slot can be cut in the band for an opening to receive the bar. Where the piece is made from a block this is not necessary. There is one thing to remember, that the stock should be of the proper amount and shape and good soft heats used. I believe that more failures come from these two reasons than any other. After passing the piece through this tool and allowing it to cool, the fin or splash is trimmed cold. The trimmer is a piece of hardened tool steel the shape of the piece which is being worked. This block is placed on the hammer die and the forging is driven through.



Dies for forming locomotive spring hanger ends

Discussion

Drop forging is not a game to play with for it is a difficult problem to study, especially with the idea of reducing costs. It was generally agreed that dies used

in shop forging work should be made of special steel and not from scrap material, such as old car or locomotive axles. Some scrap axles will harden, while others will not, so such material is not always dependable for making dies. Fine steel usually stands the wear pretty good but it is not as good as steel made especially for die blocks.

Drawbars and pins

By Alexander MacDougall
Blacksmith foreman, Bangor & Aroostook, Derby, Maine

We have three kinds of conections, namely: the solid bumper, wedge and spring. We find that the solid bumper and wedge are hard on the drawbars and pins. The spring bumper is applied as the locomotives go through the shop. The slack is taken up at the engine house by putting a plate between the bumper, or back of the spring. These are removed as the locomotives go through the back shop and the bar is made to the proper length. If the holes are worn oblong, they are upset to the proper size and if the metal between the hole and the end is too thin, a piece is welded on the end to make it the proper thickness. The solid bars are made of hammered iron and the pins of machinery steel. Our latest locomotives are equipped with two bars placed side by side.

For some years we have been making drawbars of ½-in. tank steel. The plates are cut the right width to leave plenty of stock around the hole, the center is cut down to 5 in. with the acetylene torch and sheer. Enough plates are used to make the bar the right thickness and a "U"-shaped yoke of 1-in. round iron is placed around the center, with a piece of 1-in. by 2-in. iron clamped across it, double nutted and screwed down tight. The drawbar is then sent to the machine shop to have the holes drilled.

This makes a good flexible bar and so far we have had no failures. When it is necessary to shorten them, the yoke is taken off and each leaf is shortened and put together again. Very little slack is allowed on the Bangor & Aroostook; if there is ⅛ in. slack, it has to be taken up.

Discussion

Some of the speakers reported that it was the practice on their roads to use scrap car axles for this purpose. It was generally agreed, however, that the carbon content of the steel in car axles was too high to make satisfactory drawbars.

The problem of reclaiming drawbars having worn holes led to some discussion as to the advisability of this practice. Some roads make a practice of upsetting the drawbar on a die that extends up the side of the head in order to prevent the hole from being flattened during the upsetting process. Other roads make it a practice to build up the hole with oxy-acetylene welding. It was contended, however, that the heat evolved in the welding process tended to crystallize the metal and thus weaken the drawbar. It seemed to be the concensus of opinion that it was poor practice to weld a liner inside the hole.

Frame repairing

By P. T. Lavinder
Blacksmith foreman, Norfolk & Western

We formerly used the electric welding process exclusively in repairing broken locomotive frames, with the exception of the smith shop forge welds. The electric welding process has been replaced by the oxy-acetylene when welding frames in position on the locomotive. When a frame is removed from the locomotive and welding is necessary, we recommend that it be forge welded in the smith shop.

The following is a complete record of the results obtained on the Norfolk & Western during the past 17 months by the various welding processes.

Kind of weld	No. welds made	No. welds failed	Per cent failure
Oxy-acetylene	757	28	3.7
Smith shop forge	12	0	0
Electric	58	14	24
Total	827	42	5

In making oxy-acetylene welds on locomotive frames we proceed as follows:

1—Remove all parts necessary to provide expansion and to allow free access to both sides of the frame.

2—Make sure the frame is in line and properly blocked so that it will stay in perfect alinement during welding.

3—Tram the frame, using a one-piece tram and have the tram marks, if possible, not closer than 12 in. to the break.

4—Vee out the frame at 45 deg. angles all the way through, from both sides, using the oxy-acetylene cutting process.

5—Spread the frame for expansion, allowing ¼ in. to ⅜ in. according to the size of the frame.

6—The scarfs of the vee must be chipped or brought to a red heat and cleaned with the welding torch to remove all burnt metal before starting the weld.

7—Use a plate under all vertical welds; the plate should stand away from the frame ⅛-in. to allow perfect fusion at the bottom of the weld. When the weld is completed remove the plate and finish smoothly on the bottom with a welding torch.

8—When a weld is broken always cut out all the old weld and make a new weld on good sound metal.

9—If this makes a gap over 2-in. in the center of the vee, cut out a section of the frame not shorter than 6 in. and weld in a new piece.

10—In some locations a new section is welded in where old welds have been made, or where flaws are found.

11—On frames 5 in. by 6 in., or larger, a preheating furnace is used and a charcoal or coke fire is carried around the frame at the point of the weld during the welding. When the weld is completed the furnace is removed and the weld is wrapped with asbestos to permit slow cooling.

12—On smaller frames, the frame is wrapped with asbestos for a distance of 12 in. on each side of the weld to hold the heat during the operation. When the weld is finished, it is wrapped with asbestos to permit slow cooling.

13—When a weld is started it must be continued and never allowed to cool down until finished and must be welded from both sides at the same time.

14—All welds are reinforced not less than 20 per cent when clearance will permit.

15—The spreader is generally removed immediately after completing the weld, but good judgment must be used in this matter as there is sometimes danger of upsetting if the spreader is removed too soon.

16—Successful frame welding will depend upon two main factors; namely, proper preparation and competent welders.

We attach a record plate to all frame welds showing the engine number, name of the welder, kind of weld, place and date welded. The plate is numbered showing the number of times the frame has been welded in the

same location. A report is then made to the office of the superintendent of motive power, giving the same information, and in case a weld fails, the record plate is removed and sent to the office of the superintendent of motive power, thus making it possible to keep a complete record of all frame welding.

Reclamation

By Walter Constance

Blacksmith foreman, Chesapeake & Ohio, Barboursville, W. Va.

The Chesapeake & Ohio has no large central shop for reclamation. Most of the articles are usually reclaimed in the general shops. Brake beams are repaired at six different points. Couplers are straightened, truck sides and body bolsters are repaired, all-steel car parts and even steel center sills are reclaimed, for the most part, at the large central shops at Huntington, W. Va. All track tools for the entire system are brought to Huntington by the supply train. Special dies for Bradley hammers are used to make chisels, spike mauls and picks. All tamping ends for tamping picks are upset upon 2½-in. Ajax forging machines. We can make from 1,000 to 1,200 tamping ends in eight hours, using one forging machine man and one additional smith to do the work of hardening. In cases where the tamping picks are too short to upset, they are made into clay picks, one end being built up by welding where necessary.

Tire steel is used to make blacksmith tools and some kinds of draft keys. Electric welding saves much of the material around the shops that formerly was scrapped.

Discussion

The reclamation of scrap car axles was discussed by a large number of those present. It is practiced to a limited extent by a number of roads throughout the country, but only one railroad shop, located in the middle west, seems to have taken up this work extensively. All of the work for reclaiming car axles for the entire system is centralized at this shop. During the past ten years some 30,000 scrap axles have been returned to service at the annual saving estimated at $40,000. Worn axles are returned to service as a standard axle of the next smaller standard size.

The scrapped axles are placed in a furnace and heated for half their length. When the axle reaches the desired heat, it is swung to a 4,000-lb. double-frame steam hammer on a jib crane. The end collar or "button" is drawn down to size by three or four blows in the smaller groove of the hammer die and the wheel seat collar is drawn down to the size of the wheel seat in the larger groove. The axle is then returned to the furnace, the other half is heated and the above operations repeated.

If the axle is slightly bent, it is straightened and the length between the fillets at the inside of the journal is gaged for correct length. If the axle is too short, it is drawn slightly at either side of the center so as to restore it to the required length. After the end collars have been upset and all forging work completed, the axle is annealed, allowed to cool overnight and is then forwarded to the lathe department for turning.

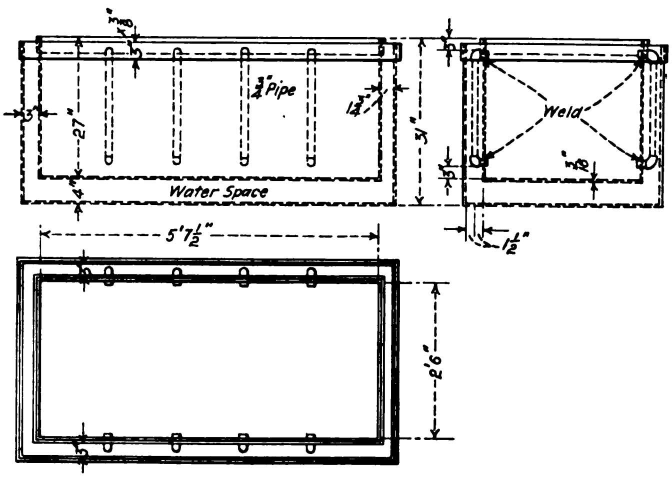
Spring making and repairing

By Geo. H. Corcoran

Blacksmith foreman, Grand Trunk, Battle Creek, Mich.

Springs received from outside points have the bands removed. All broken and worn leaves are replaced with new steel, the springs are tested and returned to service. Springs removed from locomotives in the shop for repairs are sent to the spring department where they are inspected and if found defective are repaired. Springs found to be all right have the proper height and carrying test load stencilled on them and are then returned to service. Spring leaves are heated in a fuel oil furnace to 1600 deg. F., formed on a Ryerson leaf forming machine and cooled in a tank of Houghton's Soluble No. 2 quenching oil. They remain in this oil until cooled down to 900 deg. F., or what is called a flash temper, and this leaf is used in the forming machine for bending the next leaf in shape.

The oil tank is placed in a larger tank which is surrounded by running water. It is equipped with 8¾-in. pipes, four on each side of the tank. These pipes run out from the side of the oil tank, about 2 in. from the top and down through the water and again into the oil tank near the bottom. When a hot leaf is placed in the oil, the hot oil comes to the top, flows out into the side



Spring tempering vat

pipes, down and into the tank at the bottom. By this time the oil is cold and it automatically feeds back into the tank and never requires any attention. We have tested the oil for several weeks and the temperature was found to be between normal and 130 deg. F., which was the highest in eight hours of constant use.

The spring plant is equipped with a hydraulic spring bander, hydraulic spring band remover, combination punch and shear, spring tapering rolls, nibbler and trimmer, a pneumatic spring tester and three furnaces for heating and tempering spring leaves. All the spring leaves are painted with heavy oil and graphite before banding. Some of our spring bands are forged and welded and some are of cast steel which costs about one cent per pound less than we can forge them. We have had bood success with them. Weldless bands are used for tender and coach springs.

The writer recently visited one of the largest production spring plants in the world, which specialized on a certain class of springs. Spring leaves are fed in one end of a furnace and come out the other end, heated to 1500 deg. F. They are then placed in a spring forming machine which revolves in a large vat of quenching oil. The forming machine has four or five arms. As a hot plate is put in the machine, it clamps it to a form and is held fast to the shape while the machine revolves in the oil and cools it off. Each leaf in the spring has a special machine form and oil tank. All leaves are made at the same time so that there is no fitting of the spring plates as all leaves are a perfect fit. After the leaves are hardened, they are placed in a nitrate of soda bath and heated to 900 deg. F. and held at that temperature for 15 minutes and then taken out.

All spring steel received at this plant is tested by

metallurgists before any is unloaded out of cars. Special machinery is constantly in use for testing completed springs for load endurance and breaking point and records are kept of these data. Brindell tests are made and a hardness of from 387 to 418 is required.

There is no doubt but that a great change is about due in railroad shops for making springs in a more scientific way. A few roads are making them that way now, but not many. Most of us are depending on our spring makers and while we are fortunate in having good spring makers, we do have to rely on their good judgment for getting good springs and we know that what they do has a certain "chance" element. When we have the equipment to make a spring scientifically, step by step, then we will feel that we have made a spring that can be depended upon. While we know that some scientifically made springs do break, they are a thousand times more reliable than when made by "chance."

Proper heat treatment is an important part of spring making. Accuracy in the proper degree of heat for hardening and drawing back is vital to the life of a spring. Electric furnaces are most accurate for controlling the temperature as they will keep within five degrees of any desired heat, thus making it possible to give every leaf in the spring the same heat treatment. It is not so with oil because of lack of uniformity. One tank of oil will be heavy, another light or medium. One oil will burn clear and free, another dead and smoky. With these and varying degrees of heat, it is impossible to keep a furnace at a fixed temperature in order to obtain constant results.

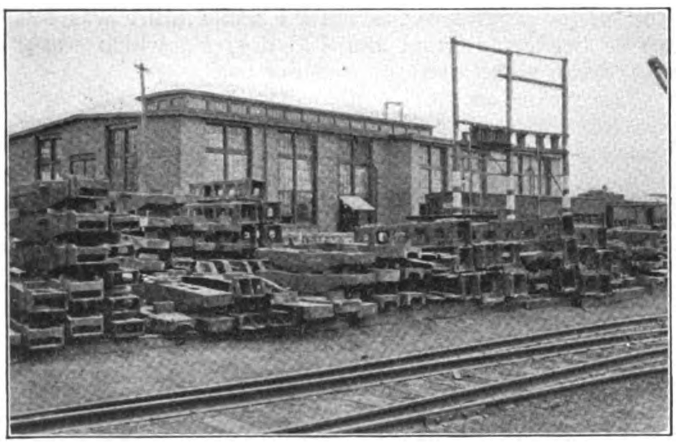
Vanadium spring steel will also probably come into more general use. It was tried out some years ago on a number of railroads but it did not make any better spring than the carbon spring steel. Today with a better understanding of the right heat treatment, there is no doubt but that it will make a much lighter and better spring than the carbon spring steel.

Welding in railroad shop practice

Equipment and methods used in Santa Fe shops at Albuquerque, N. M., insure dependable work

WELDING practices employed in the Santa Fe shops at Albuquerque, N. M., are probably as good a representation of best railroad practice as can be found. The shops were built about two years ago and accordingly the equipment used is for the most part new. On the other hand two years have elapsed since it was installed and in this time means have been devised for using the equipment to best advantage.

The shops include roundhouse, car shop and back shop.



A pile of truck side frames, truck bolsters and body bolsters reclaimed by welding

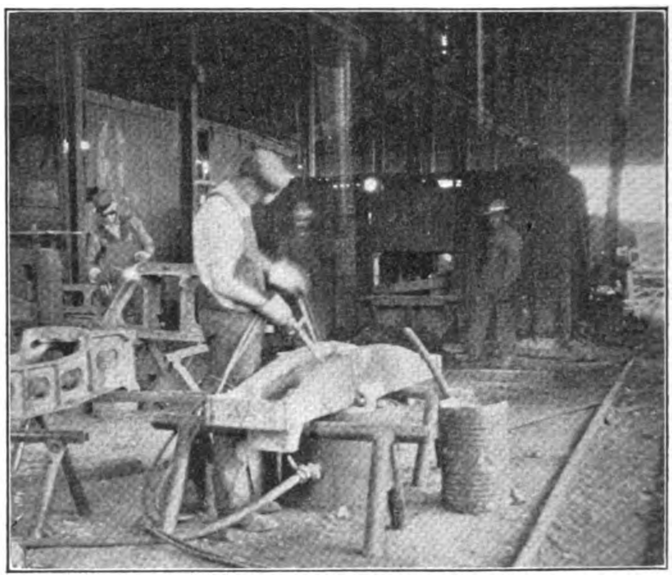
The back shop is now turning out something over 300 classified repairs a year and normal annual output of the car shop is 1,200 heavy car repairs.

Equipment

Both the gas and electric process are used, the gas being used for welding and cutting, the electric for welding only. The electric arc welding equipment consists of six portable electric welding machines in back shop, two in roundhouse and one stationary type in welding shop, which furnishes current for four operators.

The flue welding shop is equipped with one small and one large electric flash or butt welding machine, the small machine being used for safe ending flues from two inch to two and one-quarter inch diameter; the large machine is used for all flues of larger sizes.

There are also two portable electric arc welding machines in use at the car department for welding of car castings.



Welding shop in the car department, showing the preheating forge, horses for supporting the castings and the annealing furnace

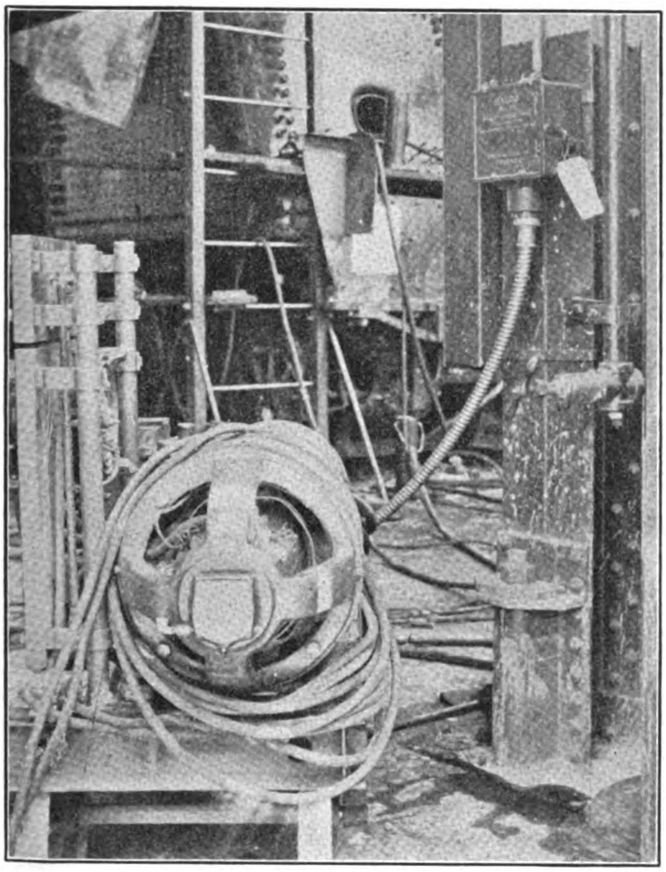
All car repair work is done in the car shop or yard. Small locomotive parts that can be moved easily are taken to the welding repair shop and the welding of large parts is done in the back shop.

The car shop, roundhouse and back shop are piped for both acetylene and oxygen. The acetylene is carried at a pressure of from 7 to 8 oz. in a 4-in. line with smaller

laterals. A 2-in. line and a pressure of 55 lb. is used for the oxygen. The oxygen is purchased in cylinders. A number of cylinders, connected through a manifold, supply oxygen to the pipe line. Practically all of the acetylene is generated in a small generating plant in the shop and supplied to the pipe line from this plant. A few cylinders of acetylene are kept on hand for use on a portable outfit that can be taken to outlying points.

In the locomotive department there are about 200 gas stations or outlets and there are 87 on the repair tracks and in the car shed. On the erecting floor the gas stations are located in the pits and on the machine side they are placed on the columns. The welding and cutting torches are fitted with 50-ft. hoses.

The electric welding sets are operating from a 230-volt direct current circuit in the back shop and roundhouse and from a 440-volt, 3 phase alternating current circuit in the car shop. On the erecting and machine tool floors



One of the portable arc welders in service

the welding outlets are located on the columns about 6 ft. above the floor. The receptacles have an interlocking mechanism so arranged that the plug cannot be inserted or removed from the receptacle unless the switch is open. These outlets are also used for the operation of portable lathes and motor driven cylinder boring bars.

The motor of each welding set is provided with a six foot lead or armored cable and a plug for connecting to the power supply outlets. The lead is made short so that the set must be close to the column when it is connected and cannot be set so as to obstruct the aisles. The generators are provided with cambric insulated, braid covered welding leads from 50 to 70 feet long.

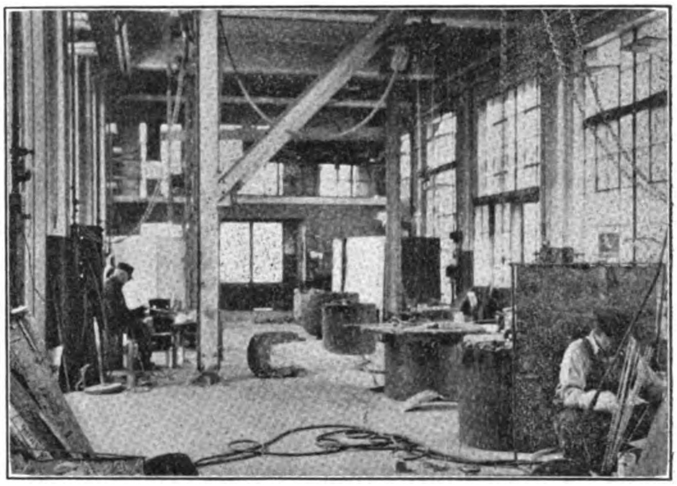
Car department welding

Welding has been applied to the work of the car department on a large scale with surprising results. The bulk of the work done consists of welding cracked truck side frames, truck bolsters and body bolsters in accordance with A. R. A. rule 23.

The sections to be welded are first inspected to determine whether or not the fractures are within the welding limits. Before a weld is made the piece is cleaned with a sand blast. The crack is V'd out with the cutting torch and the slag chiped off with a cold chisel and hammer. The weld is then made either with the electric arc or the gas welding torch.

When the torch is used, the member to be welded is placed over a pre-heating forge with the ends of the section on horses. The horses were built by the welding process from 3-in. pipe. The forge is made of a piece of 24-in. pipe about 20 in. long. About 6 in. from the lower end there is a circular grate with a piece of ¼ in. pipe projecting through the center. The pipe is supplied with air from the shop air line and the amount of blast is regulated by a valve just outside the forge. The forge burns coke and is used to heat the part of the casting on which the weld is made. This procedure has been found to improve the character of the weld and to reduce the amount of gas required to make the weld.

After the weld is made the casting is picked up by a 1½-ton chain hoist on a post crane and placed in an an-



The welding shop

nealing furnace. The furnace has a capacity of four castings and burns oil. The castings are heated to a temperature of from 1,400 to 1,500 deg. F. after which they are removed and allowed to cool. They are then given a final inspection and replaced in service. All truck side frames and bolsters which are welded are marked to show the shop in which the weld was made, the operator who did the work and the date the work was done. Thus AQ-6-3-5-25 would signify that the work has been done at Albuquerque by welder No. 6 on the fifth of March, 1925.

The normal output of the car shop is about 100 cars per month. The savings effected by welding in this department alone, not considering scrap value, have been shown to be $6,000 a month. The welding is done by 5 gas and 2 electric operators.

Locomotive department welding

The work done by the locomotive department has so many ramifications that it would be difficult just to make a list of the jobs done. For this reason only a few of the outstanding or unusual jobs are mentioned here.

The method of applying shields to superheater units or tubes, is one operation, which has proven to be highly

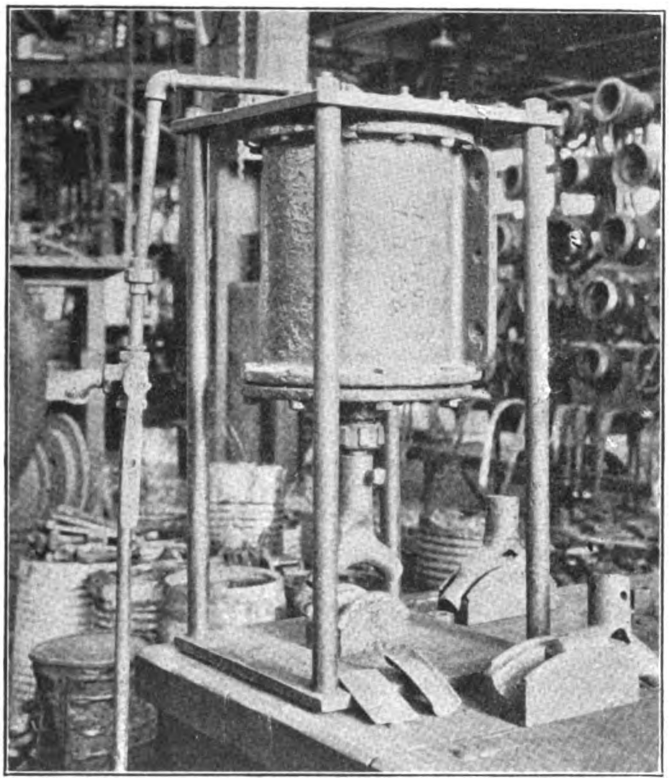
profitable. There are two places in the curved-up ends of the tubes where they are cut by cinders. To prevent damage from this source a piece of No. 14 or No. 16 steel plate is formed so as to fit the outside of the tube, and is placed over the section that is subjected to wear. It is held in position by four tack welds at the corners. The protecting plates are formed in a die, operated by an air cylinder.

The feed and elevator screws on stokers when worn by the action of the coal are built up by either the gas or electric process. After the edge of the screw has been built up it is left rough as welded. The welded edge is sufficiently accurate for the purpose and the surface of the weld withstands the action of the coal effectively. Stoker rack teeth are replaced with electric welding and machined after welding.

These and many others can be cited as examples of the importance of welding in the locomotive department.

Welding shop

Portable locomotive parts which require welding are taken to the welding shop. It is housed in a one-story building, 30 ft. wide by 90 ft. long. There are ten gas stations in the building and four electric welding outlets. Current for electric welding is supplied by a four-operator stationary welder mounted on a platform or balcony at one end of the shop. Polarized battery charging re-



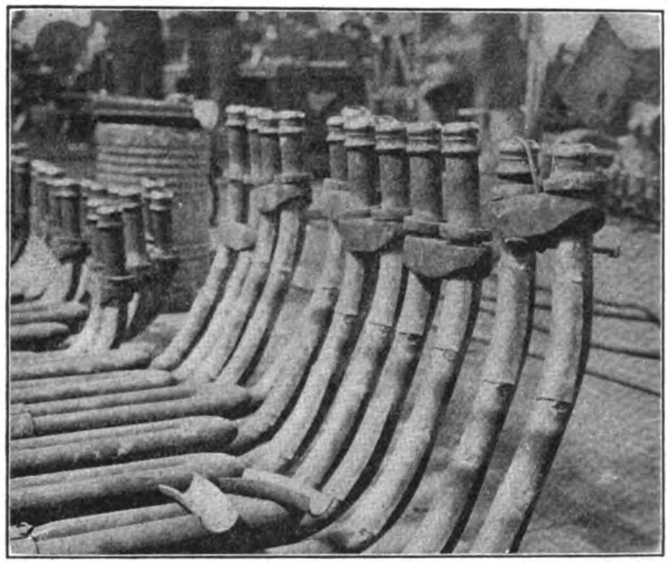
Press and dies for forming superheater reinforcing plates

ceptacles are used as welding outlets and 50 ft. welding leads and shop-made electrode holders are used.

The shop is also equipped with three-coke-burning, preheating furnaces, two 1½-ton and two 3-ton air operated jib hoists, six welding tables, a heavy vise, a cutting table and an exhaust hood for brass welding. The welding tables are 22-in. high and have legs made of 3-in. pipe. Originally the tops of these tables were covered with fire brick, but a piece of ¾ in. boiler plate was found to be a more satisfactory top and a piece has been laid on top of the brick on each table. The cutting table consists of a large iron kettle across the top of which have been placed several pieces of scrap boiler plate so as to form a sort of grill on which the material is cut.

Testing operators

In order that officials in charge of welding and the welders themselves may know what kind of welding is being done from month to month, it is the practice of the Santa Fe Railway to have each welder furnish a test plate monthly. The manner in which this plate is made and tested was described recently in a paper by E. E. Chapmen, engineer of tests and H. H. Service, supervisor of welding equipment, presented before the Chicago section



Some reinforced superheater units

of the American Welding Society. The procedure is as follows:

Secure two pieces of boiler steel ⅜ x 2½ x 9 in., bevel one end of each to form a 90 deg. angle between them, place the two plates in a convenient position for welding with 3/16 in. opening at the bottom of the "V" and make the weld from the top side only, reinforced a maximum of 20 per cent over stock size on one side only, if welder desires this much reinforcement to produce his best weld.

It will be noted that in this test plate the weld is allowed to be reinforced 20 per cent over stock size, more than that is milled or ground off, and plate to be welded only from one side, in order that the welder can approximate the condition of welding a side sheet or its equivalent in a firebox. The welder is instructed not to forward any weld for test unless he is satisfied that it is the best he can make, and representative of the work he does. These welders are then rated according to the percentage strength of their welds which is based on the thickness of the original stock, and an ultimate strength of 60,000 lb. per square inch. It is the desire to have welders stimulate actual working conditions as nearly as possible, and it is also endeavored by the foreman to have the welder complete his work at the original heat and avoid the plastering over of metal incident to reworking and consequent weakening of the original weld. From the test data thus obtained the foreman has sufficient information at hand to judge the welder's ability to produce good work and it will justify him taking proper steps for keeping the welding up to a high standard by correcting the faults or assigning only the men who are able to make satisfactory welds to the more important welding operations.

Tests have also been made to determine the relative efficiency of welded specimens to the original stock, under vibration or alternate bending, but this is a comparative

proposition and not one that can be used as a regular control.

Welding efficiency

An analysis was made of specimens tested for the years 1920 and 1921 to show the average efficiency of welds produced by welders having different years of welding service and the results are shown in Table I.

TABLE I

Years service as welder	Welded specimens tested: Gas	Electric	*Efficiency of weld—per cent: Gas	Electric
Less than one	195	147	75.8	90.6
One	93	81	89.2	93.2
Two	177	131	85.8	92.9
Three	78	72	84.4	95.2
Four	47	10	90.6	96.9
Five	27	..	96.7	....
Six	4	6	98.3	101.0
Seven	3	9	74.6	94.9
Eight	16	..	82.4	....
Nine	7	..	89.6	....
Total	647	456	Ave. 86.7	95.0

* These efficiences are values based on a tensile strength of 52,000 lb. per sq. in., the minimum value allotted in specifications for firebox steel.

It is noted that for the seven and eight years welding service the value showed a great deal below the average which was due to a poor welder working in these two groups, but the indications are that the longer the service the greater the skill shown by operators. It will also be noted from this tabulation that for strength alone the electric welding shows up better than the oxyacetylene welding. However, for the year 1923, a check of this relation shows that due to improvement of the kind of metal used for welding with oxyacetylene the results of the latter are about on a par with the electric welding for strength.

The results obtained in four of the largest shops and in four of the largest roundhouses of the system are shown for the last three months of the year, October, November and December, 1924, in Table II.

TABLE II

Shops	Welded specimens number tested: Gas	Elec.	*Specimens broken outside of weld, per cent: Gas	Elec.	†Efficiency, per cent specimens broken in weld: Gas Min.	Gas Ave.	Electric Min.	Electric Ave.
Topeka	29	46	24	24	77	101	75	96
Albuquerque	63	32	62	53	57	99	75	101
San Bernardino	31	34	45	38	84	104	88	104
Cleburne	16	9	63	33	68	90	83	98
Total	139	121	..	..	..	..	..	..
Minimum	..	..	..	..	57	..	75	..
Average	..	..	50	37	..	98	..	99
Roundhouses								
Winslow	9	9	56	33	101	108	98	105
Amarillo	8	8	75	75	103	103	78	89
Newton	22	32	46	22	80	99	88	100
Shopton	25	22	52	36	83	98	79	103
Total	64	71	..	..	..	..	..	..
Minimum	..	..	..	..	80	..	78	..
Average	..	..	53	34	..	100	..	101

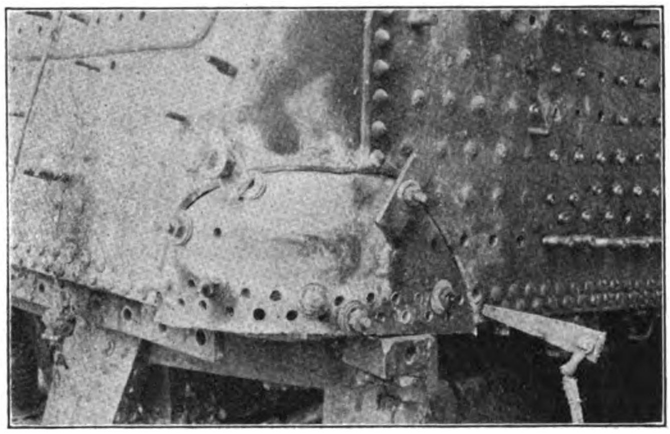
*This column also includes welds which showed 60,000 lb. per sq. in. tensile strength.

†Efficiency based on firebox steel, 52,000 lb. per sq. in. minimum tensile strength.

It will be seen from these figures that a butt welded seam with a maximum reinforcement of 20 per cent of stock averages well above the 45 or 50 per cent efficiency allowed for single riveted seams.

It is believed that for a large railway system like the Santa Fe too much stress cannot be laid on demanding of welders that they produce the proper strength of welds as shown by their test specimens so that both the management and the welders may know when they are doing acceptable work. The test pieces are returned to originating shops and the results discussed with the individual men by the foreman in charge. The system supervisor of welding equipment and service company representatives also go over the results of weld tests with the men and make suggestions for the betterment of the service.

From this it will be seen that the railway management exercises a systematic control over autogenous welding operations, especially as it concerns the welding of boiler and tank steel plates. This, of course, is only one phase of the rather extensive use of these welding methods and the periodic control can easily be exercised, but there is a very extensive amount of work where such control cannot be so applied. Problems, such as best procedure and method of welding locomotive frames, bolsters, couplers, cylinders, where heating and subsequent annealing are required, and many similar questions require careful service observations or comparative tests. The question arrives as to whether it is practical to weld certain kinds of material, whether hot or cold, whether to use cast iron or steel rods for welding material, and with such questions raised many tests have been conducted to increase the list of "Dont's" for anything not prohibited is assumed to be permissible.



A sample of welding in the boiler shop, showing the method used for grounding one side of the electric welding circuit

Material used

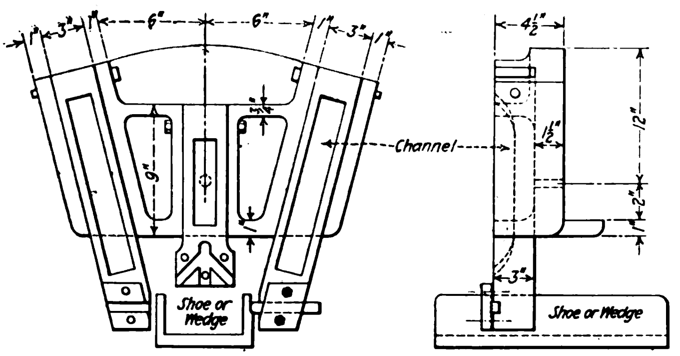
Norway iron welding rods are used for plugging holes and building up worn castings and steel rods are used for all work requiring high tensile strength. Steel electrodes are used for welding fire boxes, building up spots on locomotive frames and all steel castings, etc. Steel electrodes are also used for fire box work flues and for welding broken locomotive frames. Pure iron electrodes are used for flues and flexible stay bolt sleeves, etc. Tobin bronze is used for air pumps, and some cylinder work, but is not always used for repairing broken cast iron castings. Manganese bronze is used for building up rod brasses, galled places on main rods and worn spots on cross heads. Work that cannot be machined is ground down and finished with grinders.

Welding instructions

Data on new classes of work have been carefully compiled by the supervisor of welding equipment and in compliance with instructions from J. Purcell, assistant to the vice president in charge of mechanical matters, these data were issued as a standard pamphlet, designated "Oxyacetylene and Electric Arc Welding Folio," for the instruction and guidance of those who have direct supervision of welding in the various shops and roundhouses on the system. This welding folio is kept up to date by frequent revisions and as better methods are devised and better welding materials are developed, and tried out with satisfactory results, they are included in the folio.

Tool for planing shoes and wedges

A PLANER tool for finishing shoes and wedges on four sides in one operation is shown in the drawing. This tool was developed in the Finley shops, Birmingham, Ala., of the Southern Railway. It consists essentially of a back plate provided with three tool holders, pivoted as shown in the drawing. The shoes or wedges are ganged end to end the entire length of the planer platen. The cutting tools are held in place by means of

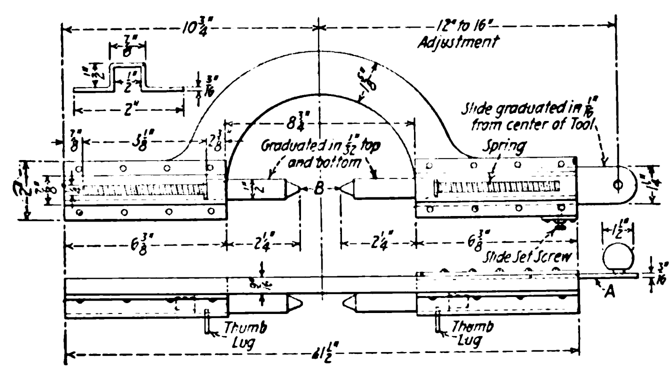


Planer tool for finishing shoes or wedges on four sides in one operation

clamps on the tool holders. They can be easily adjusted by partly loosening the clamp bolts and moving them toward or away from the work as desired. The back plate serves as a support for the cutting tool holders on the forward stroke, while on the return stroke, the tool holders are free to swing outwards on the pivot bolts. The center tool holder is constructed to hold three cutting tools so that both the inside faces and bottom can be planed at the same time.

Crank pin throw gage

THE throw of worn crank pins can be quickly and easily checked by the use of the gage shown in the drawing, as fast as they appear in the back shop for repairs. The ball center is attached to a graduated steel slide *A* which can be set for any desired crank pin throw. The 1/16-in. graduation marks of this slide are deter-



Gage for checking the throw of worn crank pins

mined by measuring from the center of the gage or from the center line equidistant from the points *B*. The points *B* are also on graduated steel slides which, when set, determine the exact condition of the throw of the pin.

For instance, if the crank pin throw should be 14 in., the ball center *A* is set to 14 in. The ball center is now placed in the axle center and the gage swung around until the points *B* are against the crank pin. If both of the point slides *B* read the same, it is known that the throw is correct.

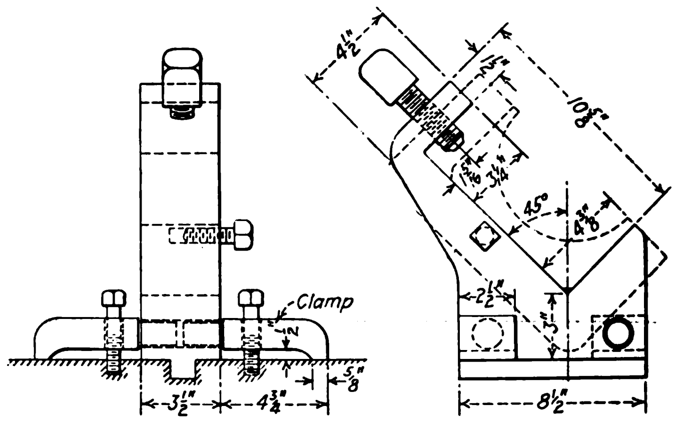
It has been found in the shops where this gage is in use that by frequent checking of the wheel quarters and pin throw, as well as careful tramming of the wheel centers from one another, troubles from broken side rods have been practically eliminated.

Milling grease grooves in main rod brasses

By E. A. Miller

THE drawings show a tool and jig for milling grease grooves in main rod brasses. This tool and jig have been adopted as standard on a large eastern railroad.

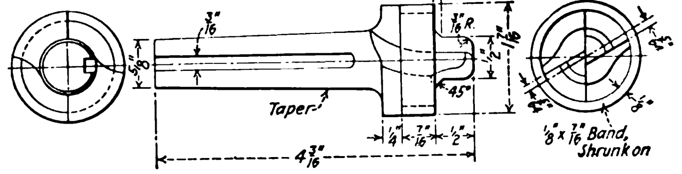
The shank of the tool is made with a standard taper.



Jig for holding main rod brasses on the shaper table when milling grease grooves

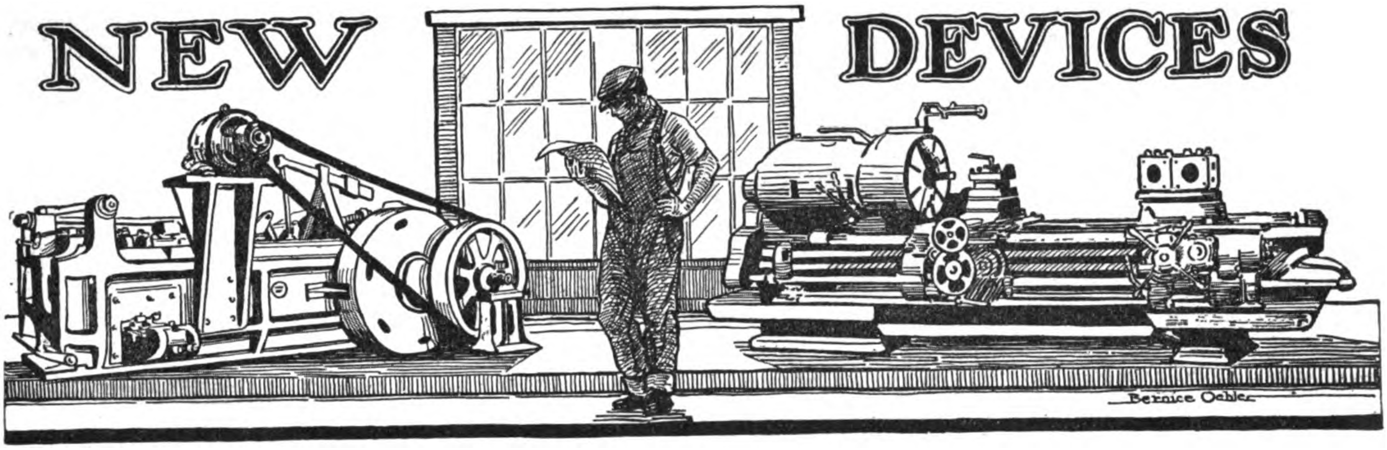
The cutters and shank are formed from one piece. A 1/8 in. by 7/16 in. band is shrunk into an offset on the head so as to provide a guiding edge for the operator to judge the depth of the groove. It also serves to reinforce the edges of the cutter. This band can be removed and narrowed down as the cutters become shorter from repeated grindings.

The jig for holding the main rod brass to the machine



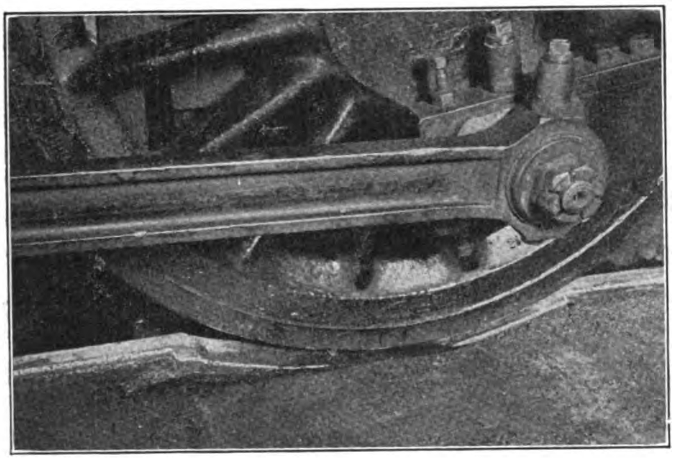
Tool for milling grease grooves in main rod brasses

table can be machined from a solid piece of wrought steel 3½ in. thick. It is clamped to the table as shown in the left hand view of the drawing. The main rod brass is clamped in the jig by means of a set screw. This arrangement facilitates the setting up and removal of the work in a short time.



Spring track assists in enginehouse work

THE Cardwell spring track has been developed recently by the Globe Railway Equipment Company, St. Louis, Mo., primarily to save time and labor in the enginehouse work. It operates on the well-known principle of the depressed track and consists of two steel rail castings, each five feet long and having a depression 3½ in. deep.

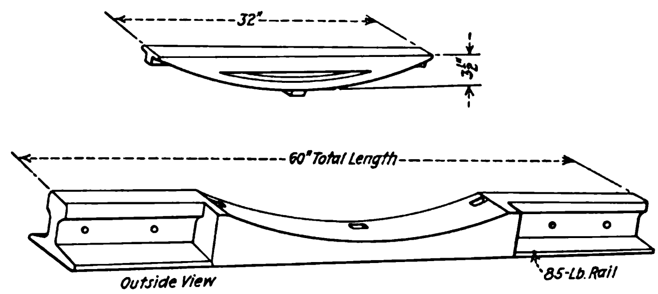


Right main wheel in the depression ready for the application of blocking over the driving box

The depression, shown in the drawing, consists of 32 in. of the circumference of a circle 10 ft. in diameter. The rail castings are inserted in one or more of the tracks inside the enginehouse.

Under normal conditions the depressions are closed by application of the removable segments which are held in alinement with the rail by lugs fitting in corresponding holes in the track castings. When necessary to perform such operations as changing engine truck wheels, shimming tires, renewing driving or trailer springs, etc., the removable segments are taken out. By blocking under the required parts of the spring rigging and running one pair of wheels into the depression, the weight can be taken off that particular pair of wheels without the labor and time involved in jacking up the locomotive, as would otherwise be necessary.

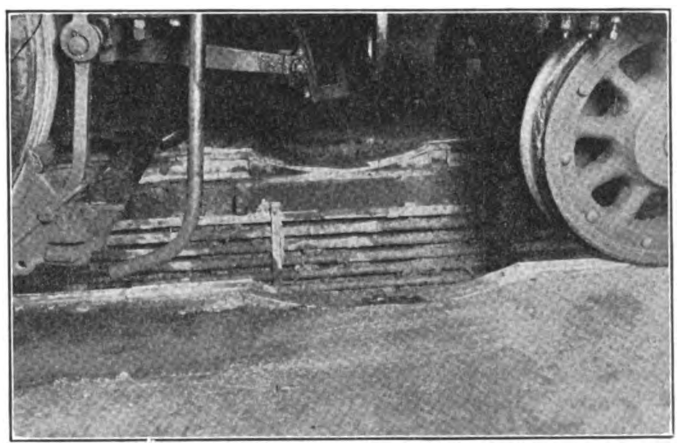
The Cardwell spring track has been in operation for several months and has proved to be entirely practicable. The provision of more than one spring track in the enginehouse, possibly one for every five or six stalls, will have a tendency to prevent delays to locomotives while a single spring track is occupied. The best location for the device is back of the driving wheel drop pit or engine truck drop pit, and, on all other tracks, far enough inside



A Cardwell spring track section

the house to accommodate the trailer wheels and still permit the enginehouse doors to be closed.

The following description of several operations using the Cardwell spring track will indicate the variety of work which can be performed with it: In renewing driving or



Removable segments can now be put in place and the track used like any section of level track

trailer springs, blocks are placed between the equalizers and locomotive frame or safety hangers in such a way that when the particular pair of wheels involved is run into the depression, the weight is removed from the driv-

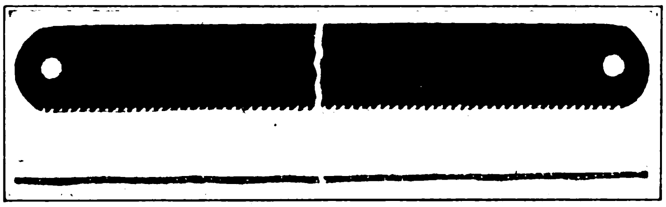
ing box or trailer housing, as the case may be. The new spring is then applied and the locomotive moved so as to pull the wheels out of the depression, the spring change thus being accomplished without any jacking up.

In cases where engine truck drop pits are not available the spring track can be used for changing either or both pairs of wheels in a four-wheel engine truck. The method of procedure in this case is to take down the truck pedestals in question and chain up the engine truck frame. The front driving wheels are then run into the depression and blocking applied between the front driving boxes and the locomotive frames. Movement of the locomotive wheels out of the depression raises the front of the engine and the front truck frame so that the defective truck wheels can be rolled out and others applied. The locomotive front end is lowered and the weight put back on the engine truck by the reverse operation.

In addition to facilitating all classes of spring work and changing engine truck wheels, trailer or engine truck brasses may be changed by means of the spring track. The effect of the device is to save nearly one-third of the time and labor involved in jacking up locomotives when necessary for one reason or another to remove the weight from various parts of the spring rigging.

Improved power hack saw blade

A POWER hack saw blade known as the wavy-set has recently been placed on the market by the Henry G. Thompson & Son Company, New Haven, Conn. The trade name has been derived from the method of setting the teeth in the blades. This method is intended to give additional strength to the teeth and to make them more nearly alike in shape. It is said, with this form of setting, that it is quite practicable to use a 10-pitch blade on thin-walled tubing.



Notice the wavy appearance of the cutting teeth of the Milford hack saw blade

The characteristic setting of the teeth is accomplished by passing the heated blades through a series of suitably shaped rollers that bend the serrated edge first in one direction and then another, imparting to the edge a wavy appearance not unlike that of a thin circular milling cutter. The waving extends away from the edge far enough so that each tooth is assured the support of the full thickness of the stock, and the abrupt bend caused by the usual method of setting is avoided, which is a desirable feature.

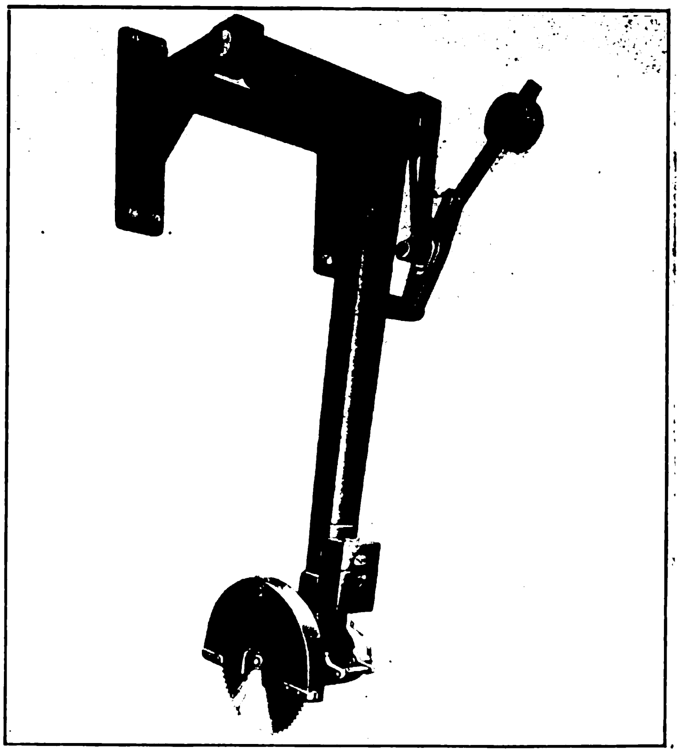
Overhead mounted wood swing saw

A SWING cut-off saw which may be mounted either on a wall or ceiling, designed for safety, lightness and ease of operation, has recently been placed on the market by the Oliver Machinery Company, Grand Rapids, Mich.

The hanger bracket is cast in one piece with a 37-in. base, machined parallel to the trunnion axis of the swinging arm. It is so designed that the machine may be mounted either on the wall or ceiling without any fitting other than placing the weight arm in the proper position. The main frame is of the rigid, single arm type, cored in a U-form. It swings on ground pins of large diameter. The counterbalance is so constructed as to give the operation of the arm an easy and lively motion. It acts on the arm at a point about one-third of the way down from the trunnions. In this location, it takes less weight to throw the arm back to the starting position and a lesser effort for the operator to throw it forward. The slot in the weight arm is shaped to bring the saw to its starting position.

The motor arbor housing is tongued and grooved to the frame with a 2-in. vertical adjustment allowed for setting up or to provide for a 4-in. reduction in the size of the saw. The housing is of a three piece rigid construction, with the end pieces of cast aluminum. The stator of the motor is mounted in the housing. The shaftless rotor is mounted on and keyed to the saw arbor. The motor has a full load speed of 3,450 r.p.m. and may be furnished up to 5 hp. for two or three phase, 60 cycles, 220 or 440 volts. The saw arbor is mounted in two radial ball bearings which run in grease and are encased to prevent dirt from coming in contact with them. The arbor carries two 4-in. diameter saw collars, a nut and a 16-in. saw blade.

The machine is covered with a one piece cast guard over the top and sides with a hinged steel plate on one

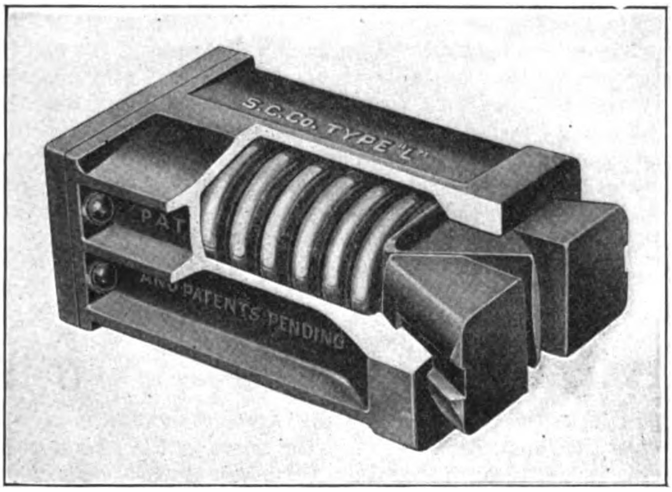


The motor of the Oliver swing saw is mounted on the arbor head

side which can readily be lifted back in order to change the saw blade. The machine is lubricated by means of the Alemite system. When furnished with an 18-in. saw, it will cut planks 12 in. wide and 3½ in. thick. It is approximately 7 ft. 6 in. from center of saw to base of ceiling hanger.

High capacity draft gear

TWO fundamental conditions have vitally affected the efficiency in service of all draft gears. On the one hand there has been the continued trend toward the use of larger and heavier cars, more powerful locomotives and longer trains. On the other hand there is the continued inflexibility of standard overall dimensions within which, for purposes of interchangeability, the draft gear is required to fit and function. Accepting these conditions as the most desirable ground work on which to build, the Sessions-Standard Type L friction draft gear manufactured by the Standard Coupler Company, New York, has been designed for the purpose of combining the following characteristics: High capacity, increasing progressively and uniformly with the gear travel; ample recoil; sturdiness and oversolid strength; 2½-in. travel, all friction; substantial initial compression, both spring and friction; only five parts; electric steel housing.



The Sessions-Standard draft gear designed to give a substantial initial compression and high absorption of energy

Using a tup of 9,000 lb. falling 2 ft. ½ in., an average capacity of 18,375 ft. lb. is obtained. The average absorption of energy is approximately 75 per cent. Thus, the recoil is ample to insure a positive and prompt restoration of the friction elements to the working position and, correspondingly, to insure against sticking.

The 2½-in. of travel is all friction and the gear capacity is progressively uniform up to the closing point. Hence, the frequently encountered situation of an ostensibly high performance in gear capacity, actually accomplished in the last fraction of an inch of travel, is avoided and, as a consequence, sill and other structual stresses are kept well below the danger limits instead of being compelled to suffer the bad effects of an inefficient shock absorbing mechanism.

The provision of initial spring compression definitely retards to the maximum degree the accumulation of slack and enables the user to secure full friction travel and a long continuation of high capacity rating.

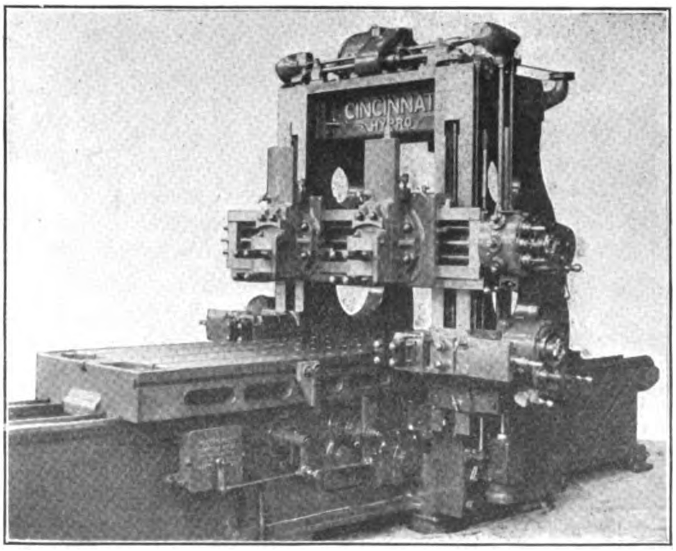
Planer designed for production work

CONVENIENCE for the operator and simplicity of design, elimination of delicate wearing parts, and fool-proof arrangement to eliminate liability of breakages is claimed for the construction of the dial feeding mechanism, rail lift and rapid power traverse to the heads of a planer recently placed on the market by the Cincinnati Planer Company, Cincinnati, Ohio.

All the heads are furnished with selective dial feeds which are graduated to 1/64 in. and arranged so that any feed up to one inch can be instantly set from the operator's position and read from the front of the machine. The rail and side head each have a separate feed with a safety feature so that they can be fed into each other without causing any breakage.

A single turn rail clamping device is used, operating through a crank handle at the end of the cross rail—one turn of this crank clamps the rail securely to the inside face of the housing. The rail clamping mechanism automatically engages the elevating gear when the rail is released and again breaks this connection when it is clamped, making it impossible to engage the elevating mechanism while the rail is clamped. Automatic stops limit the maximum travel of the rail.

The rapid power traverse is so arranged that by one movement either one or both rail heads may be moved across the rail and the tool moves up or down at the same time. Any one of these movements can also be secured independently and instantly, the whole being operated and reversed through one lever. Both side heads are provided with rapid traverse independent of the rail heads. A



Operating levers and points of lubrication conveniently located on Cincinnati planer

slip clutch is used so that no damage results if any one of the heads are run together or beyond their limit. All the control levers are centrally located.

The housings are designed not only with wide faces but so that the heavy thrust of the side head tools is taken by a square section through metal to metal contact. To further increase rigidity at maximum height, the housings are tied together at the top by a full depth box arch, giving balance to the entire machine.

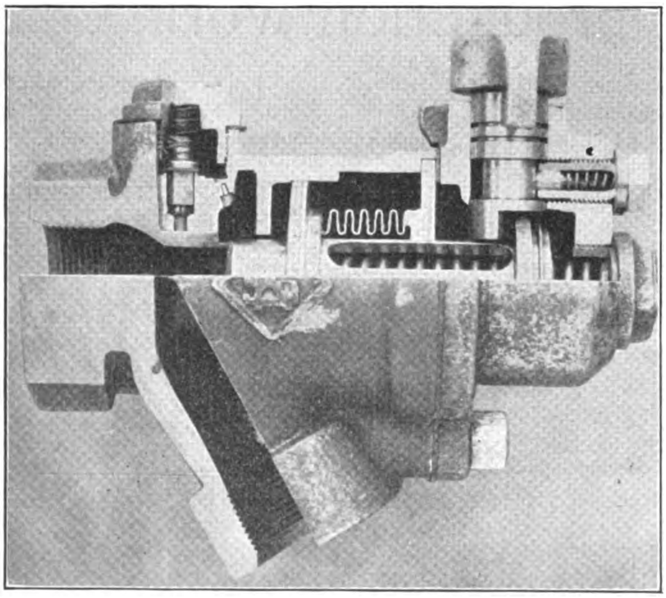
All the slides have the dove tail inverted, resulting in a much heavier cross section through the center. This type of design causes the dove tail bearings to become tighter under pressure. Taper gibs are used throughout on sliding surfaces. Herringbone gears are used throughout the machine.

Continuous lubrication of all moving parts has been given special attention. A pump located in the bed takes oil from the tank through a strainer, then passes it through a filter. Oil is forced into the vees near the center of the bed and distributed through channels the full length of the table so that the table constantly rides on a film of oil. An abundance of oil is always present on short and long strokes. The overflow forms a head or volume in the vees in the front of the table, flushing out any small particles of dirt into the strainer at the end of the bed, thus washing them clean at each stroke of the planer. All the gears in the bed revolve with their shafts which in turn revolve in ground bearings. Filtered oil is flowing constantly to the large chambers surrounding the main bearings, keeping them filled. Before this oil reaches the running bearing it is again filtered by passing through felt wicks. A steady stream of filtered oil is sprayed over all of the running gears. This method keeps the gears above the oil pan and prevents disturbing the sediment which, in time, forms at the bottom of the pan.

The old time oil cup or oilers have been displaced entirely by the use of centralized oil distributors which require filling only once in ten days. One of these distributors has been placed on each side head, on the elevating mechanism, at the end of the rail and one on each of the rail heads. This latter not only lubricates the revolving bearings but also all sliding surfaces. Since this oil reaches the sliding surfaces in the center it tends to keep out any dirt and insures a much longer life to parts that usually receive scant attention, if any oil at all. Proper lubrication is essential to any machine.

Semi-automatic angle cock

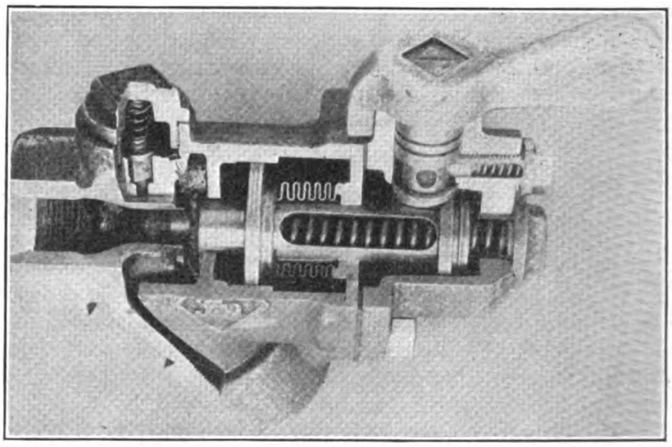
IN order to eliminate the potential danger of serious accidents due to the loss of braking power caused by accidental or malicious closing of angle cocks and yet maintain the present flexibility of the air brake system, a semi-automatic angle cock incorporating new principles has been designed by engineers and associates of the Sprague Safety Control & Signal Corporation, New York. This valve is so constructed that it will automatically maintain an open brake-pipe passage so long as the hose couplings between the cars are connected, irrespective of any accidental or malicious movement of the handle, and will also operate to close this passage automatically when



View showing the angle cock in the closed position

the cars are uncoupled, provided that the operating handle has been placed in the "off" position. It is interchangeable with the present cone valve and is manipulated in precisely the same manner. It may be mixed indiscriminately with older equipment and no changes in procedure will be required in making up train or switching cars.

In the illustration showing the valve in the closed position, it will be seen that the mechanism consists of a cylinder casting threaded at the left hand end for attachment to the brake pipe and at the lower point for attachment of



The angle cock in the open position

the flexible hose coupling. The interior of the casting is divided by an interval baffle plate with a central aperture through which projects an axial extension of the main piston; the face of the axial extension is provided with a rubber valve seat which registers with a bronze valve bushing on the end of the Venturi reduction in the air passage.

When in the "off" position with the hose coupling disconnected, flow of air past this valve seat is prevented by the pressure of the helical seating spring, shown in the sectionalized axial spring guide on the right of the piston. Brazed to the right side of the piston and to the left side of a holding guide plate is a sylphon or flexible metallic bellows. The operation of this bellows is similar to that of a flexible diaphragm except that on account of its form a much longer stroke is permissible.

With the locomotive coupled to a train and all the hose

connections made, the valve handles are turned to the position parallel to the line of the brake pipe in which they are automatically maintained by means of a ball lock. During this movement of the angle cock handle, the valve and operating piston are lifted by the opening cam against the thrust of the seating spring, and as a consequence, brake pipe air flows through the system. The handles of the rear and of the pilot angle cocks of the brake pipe are as at present left in the closed position.

Once the spring-pressed valve is lifted from its seat by means of the opening cam, brake pipe air will flow through the hose connections. This pressure will act on the face of the piston and force the valve to the extreme open position. This pressure will also gradually equalize by the piston and fill the annular space on the outside of the sylphon bellows, but the entire interior of the sylphon is maintained at atmospheric pressure. As a result an unbalanced force of sufficient moment is created by the differential air pressures to overcome the thrust of the seating spring. The piston valve will thus remain in the open or right-hand position so long as the hose couplings are made and any appreciable air remains in the system. If the angle cock handle should be moved to the "off" position accidentally or maliciously, it can not affect the piston valve as the cam is single acting toward the "on" position. Full service and emergency brake applications may be made at will through any number of angle cocks with the handle in the "off" or "closed" position.

When uncoupling cars all that is necessary is to place the handles of both angle cocks in "closed" or "off" position and part the hose. Pressure in the hose will reduce practically instantaneously to atmosphere; the slight amount of air coming through the Venturi reduction strikes the baffle plate and, owing to its peculiar form, reduces the pressure between the baffle plate and the piston to or below atmospheric by means of an ejector action. The pressure momentary trapped in the annular space to the right of the piston and the exterior of the sylphon acts as a powerful momentarily supplement to the spring, and forces the valve to its seat. The action just described is so rapid that the brake pipe air loss is hardly perceptible on a pressure gage. Once the valve has been seated, after parting of the hose, it is maintained in the closed position by the helical spring.

This semi-automatic angle cock will operate without adjustment over all ranges of brake pipe pressure from 70 lb. to 110 lb. and consequently, it is equally suitable for freight or for passenger service.

Vertical and horizontal reaming machine

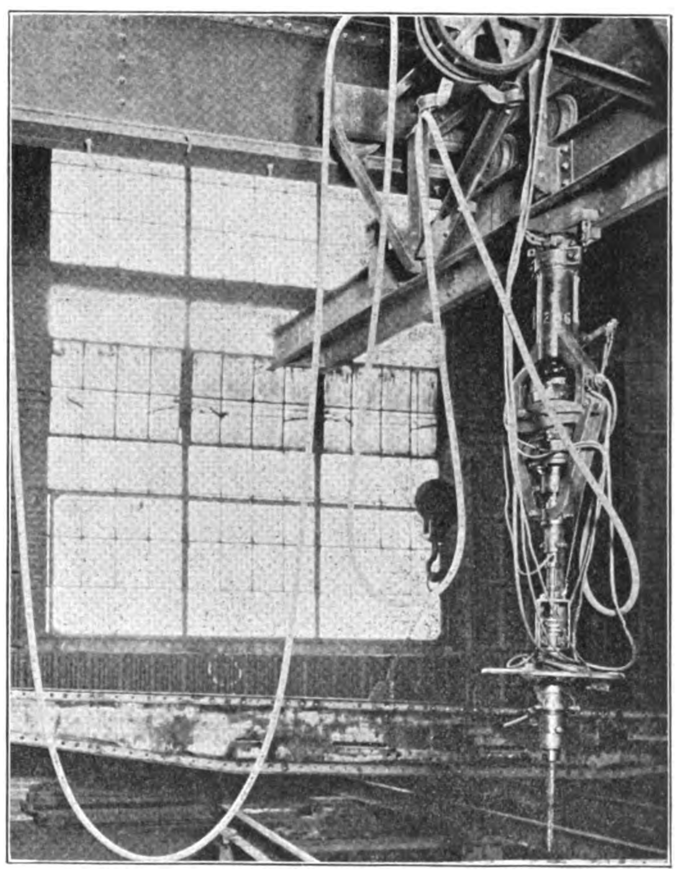
THE American Car & Foundry Company, New York, has recently placed on the market a vertical and horizontal reaming machine developed and used as standard equipment at all the plants of this company.

The machine is controlled by a single operator, who becomes skilled in its use in 10 hours or less, and can then accurately ream holes as fast as he can find them. Mounted on a traveler which can be racked forward or backward by means of an electric motor controlled by a switch located on the hand-wheel, the longitudinal spacing of holes is limited only by the length of the traveler runway. The trolley which carries the machine has been built with ball-bearings, so that a very light push on the hand-wheel will give horizontal control along the traveler bridge; here again the width of the work islimited only by the length of the traveler bridge.

The electric motor used for rotating the reamer bit has a break-test capacity of 6.9 hp., and will ream holes up to 1⅝ in. in diameter. Rotation of the armature is controlled by a contactor, which is operated automatically when the air cylinder, used for vertical control, is lowered or raised. The air valve used for controlling the air cylinder is operated by means of a clamp handle, located on the hand-wheel. A safety clutch is placed between the reamer bit and rotating armature shaft extension. This clutch is released as soon as the operator's hands are removed from the hand-wheel; and, when released, the reamer bit immediately stops rotating. Since the bit, and its extension if used, are the only exposed rotating parts, this clutch insures safety.

The machine has sufficient weight and rigidity to insure vertical reaming, and yet has a certain amount of flexibility, permitting the bit to enter holes not in the proper alinement.

Maintenance consists principally in the occasional renewal of motor brushes and lubrication. All parts are interchangeable, so that any part can be readily duplicated and all parts are readily accessible to inspection and repair. Breakage of reamer bits is practically eliminated, because the weight of the machine has been accurately determined as sufficient to drive the reamer through the hole without applying additional external force, and because of accurate central withdrawal from the hole by means of the air cylinder. Reamer bits can be changed as conveniently as a drill in any standard machine.

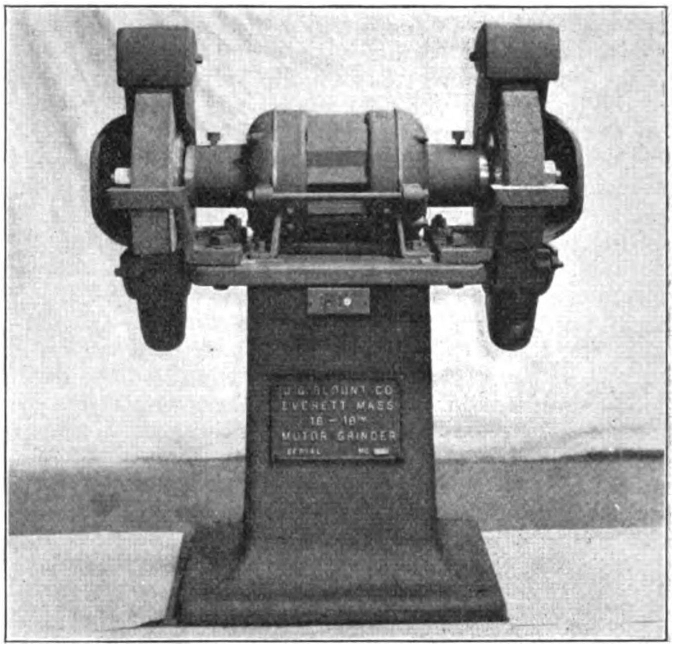


The weight of this machine feeds the reamer in holes up to 1⅝ in. without any exertion on the part of the operator

Ball bearing motor grinder

A 5-HP. ball bearing motor grinder designed for general heavy grinding work has recently been placed on the market by the J. G. Blount Company, Everett, Mass. It is fully equipped with large ball bearings of the deep groove type. The spindle is of carbon steel, turned, ground and threaded, thus insuring a perfect fit in the bearings.

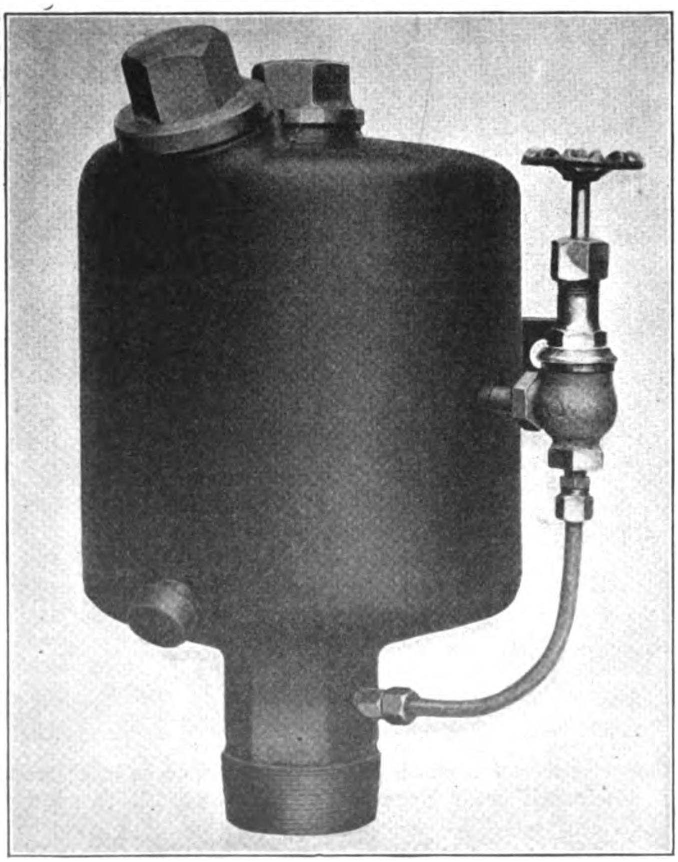
The machine is driven by a Westinghouse 5-hp., 40 deg. rated motor operated at 1,200 r.p.m. It is controlled by a start and stop push button conveniently located on the under side of the pan directly in front of the grinder which is used in conjunction with an automatic starter. The motor end shields are of cast iron, turned with a recess and bolted directly to the motor frame. These shields are also secured in position by two longitudinal bolts at the rear and in front of the motor. The end shield flanges are turned and threaded into the ends of the motor end shields. The wheel flanges on the machine are recessed on the inside. The wheel guards are of the improved safety exhaust type which have a nose-piece and removable covers which increase the sides of the wheel flange and nut for safety protection. Rest supports are adjustable to various positions. The grinder and wheels weigh approximately 1,163 lb. It requires a minimum of floor space.



Double end grinder for general heavy grinding

A decarbonizer for locomotives

THE purpose of the Ehrhart decarbonizer manufactured by the Pilot Packing Company, Chicago, is to introduce a driving journal compound into the valve chest, to prevent an accumulation of carbon in the exhaust passages and eliminate existing carbon deposits.



A cylinder grease lubricator which has no moving parts

It is simple in construction as there are no moving parts or wearing surfaces. No changes or adjustments are needed as the size of the hole in the choke is standard. It is mounted directly on the main valve chest. The tapped holes now used by relief valves may be used if available or it may be connected to the stud at the oil pipe connection, by making the stud sufficiently heavy to support it, and bracing it from the smoke box. All connections should be steam-tight.

When in operation steam enters the body of the decarbonizer from the bottom through the small opening in the choke plugs, percolates through the grease which mixes with the steam and, with each movement of the main valve, a measured quantity of grease is drawn into the valve chamber, the quantity being controlled by the standard size opening in the choke plug. This, in connection with the hydrostatic lubricator, insures thorough lubrication of all surfaces within the valve chest and cylinder, under all conditions.

There are no valves between the decarbonizer and the steam chest. It is filled with new or reclaimed driving journal compound, the filling plug tightly secured and it is ready for operation. It requires no attention from the engine crew other than to know that it is filled regularly, as it works automatically and positively.

To fill the decarbonizer, the drain valve on the side of the decarbonizer is opened to remove any possible accumulation of steam, and then it is filled with grease and the drain valve closed.

The decarbonizer shown is the No. 2 medium size, holds 3 lb. of grease and will run 300 miles without refilling. Size No. 3 holds 1½ lb. of grease and will run from terminal to terminal without refilling.

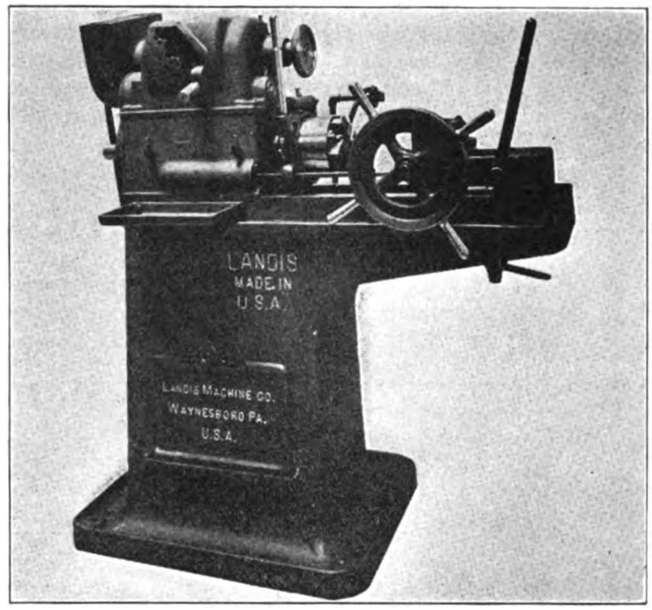
One-half inch single head threading machine

A NEW design of ½-in. single head threading machine has recently been placed on the market by the Landis Machine Company, Waynesboro, Pa. This machine has a geared headstock and a single pulley drive. The machine has four speeds, which give to the die head the following r.p.m.: 157, 226, 315 and 441.

The die head is opened and closed automatically by the carriage, or by hand at predetermined limits. The vise has a horizontal side-wise as well as a vertical centering adjustment. This feature insures a perfect and permanent alinement with the die.

A full supply of cooling lubricant is maintained at the die head by a rotary pump and there is a special control valve at the die head for shutting off the oil supply when necessary. The frame is cast in one piece with a fluid tight bottom. The driving pulley is mounted on top of the machine.

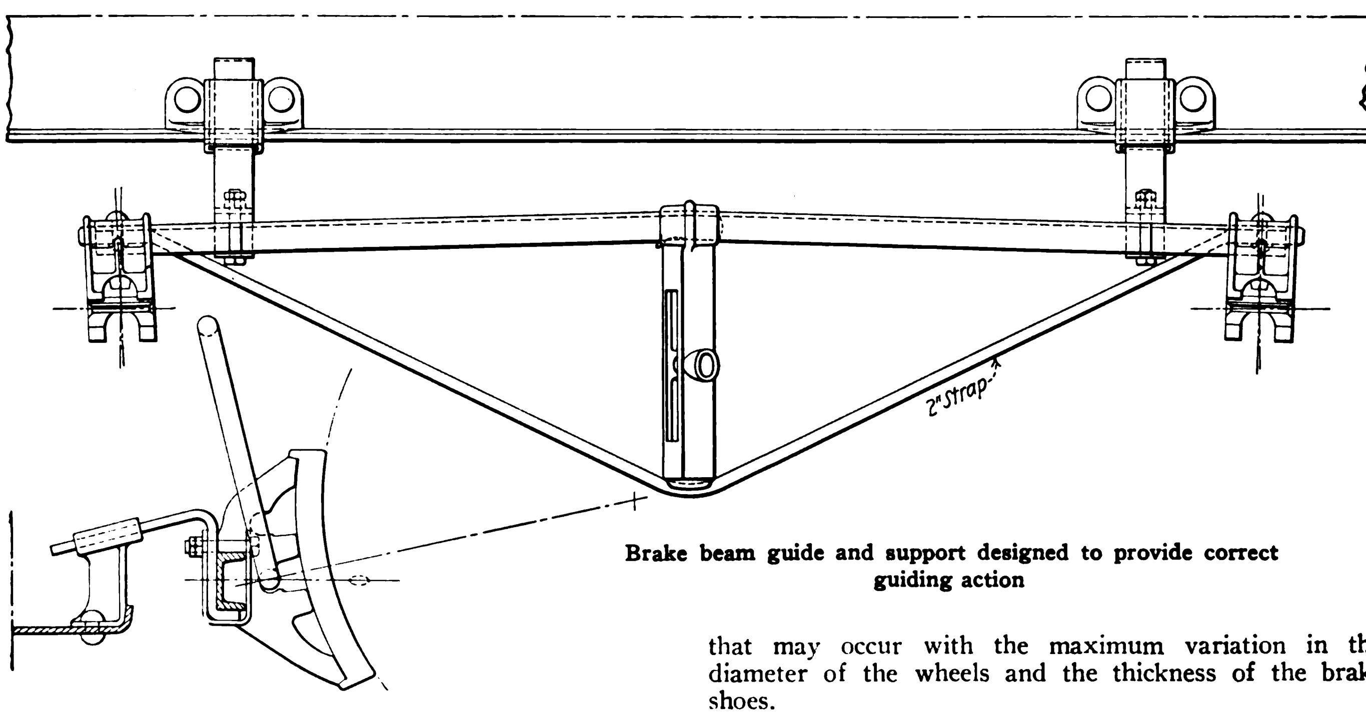
This machine is readily converted to motor drive. The power is transmitted from the motor shaft to the drive shaft of the machine by means of a belt. The motor is mounted on a plate placed on top of the headstock, so as to economize floor space, and to prevent dirt and oil from accumulating on the motor parts. The floor space occupied is 4 ft. 1½ in. by 1 ft. 11½ in. The net weight is 950 lb.



The die head is opened and closed automatically by the carriage, or by hand at predetermined limits

Huntoon brake beam guide and safety hanger

A BRAKE beam guide and support combining the advantages of simplicity, strength and superior guiding action has been introduced by The Bradford Corporation, New York. As shown in the drawing, this device consists of a guide casting riveted to the spring plank and an arm passing through the casting and bolted to the compression member of the brake beam with a bent clamp. Two of the guides are applied on each brake beam at any convenient location near the ends of the beams. The guide arm is smaller than the slot in the casting and normally is in contact only on its upper surface. The angle of the arm and the slot is such that the brake shoe is held in proper alinement to insure even wear. Correct guiding action is afforded over the entire range of travel that may occur with the maximum variation in the diameter of the wheels and the thickness of the brake shoes.



Brake beam guide and support designed to provide correct guiding action

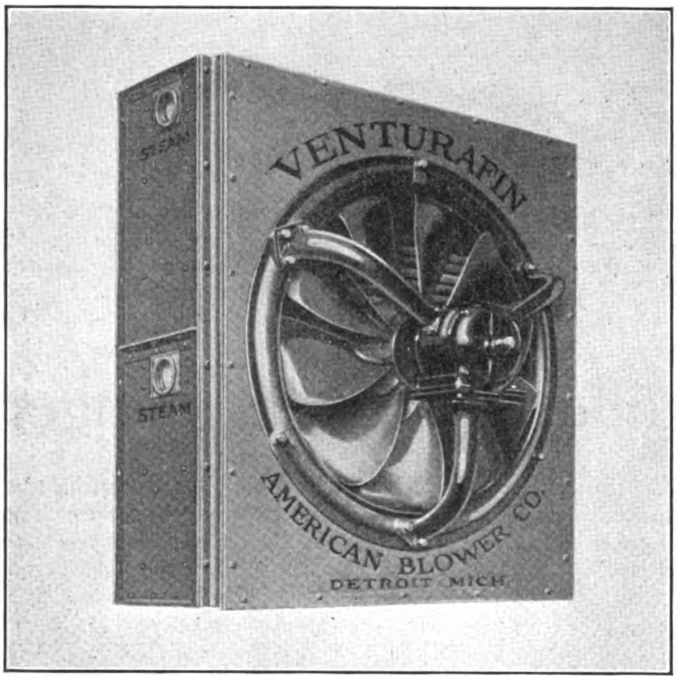
Because of the location and the construction of this guide, there is very little interference in case it is necessary to remove or replace brake beams. When the clamp bolt is removed the guide arm can be slipped through the

guide casting far enough to permit the brake beam to pass the projecting end.

One of the special features of this guide and support is the fact that it functions the same whether the frictional force applied to the brake shoe is upward or downward, and, therefore, will prevent brake beams from climbing the wheel as well as keep them from dropping. The point at which the guiding effect is exerted is a considerable distance from the hanger hole in the brake shoe and because of this condition, slight variations in the relative location of the members or the lengths of the hangers will not have any appreciable effect on the alinement of the brake shoe with respect to the wheel. The guide arm and guide casting are amply strong to withstand forces to which they are subjected in case the hanger fails to support the beam.

Heating unit of large capacity

CONSIDERABLE difficulty is often experienced in heating satisfactorily certain railway shops, or certain parts of the shop. The American Blower Company, Detroit, Mich., has recently placed on the market a self contained heating unit which is adaptable for use in such locations.



View showing general design and construction of a self contained indirect heating unit

The heating unit is light and compact. The steam tubes over which the air circulates are made of straight seamless copper and around each tube is wound a helical brass fin which increases the heat radiating surface. This fin is wound around the tubes in such a manner that much of its surface is in contact with the outer surface of the tube and this joint is later treated so that the fin and the tube become metallically integral, to facilitate the transmission of the heat from the tube to the fin.

In building these tubes into heating units, the method of assembly is simple and strong. The tubes are arranged in rows and the ends are pressed into a thin flexible copper plate, the holes in which are slightly smaller than the tubes. This gives tight flange connections which are later soldered. The flexibility of the plate takes care of expansion and contraction. Semi-cylindrical headers provided with steam connections are then placed over the ends of the tubes and locked on by means of a folded seam construction. Each unit includes a standard motor-driven fan.

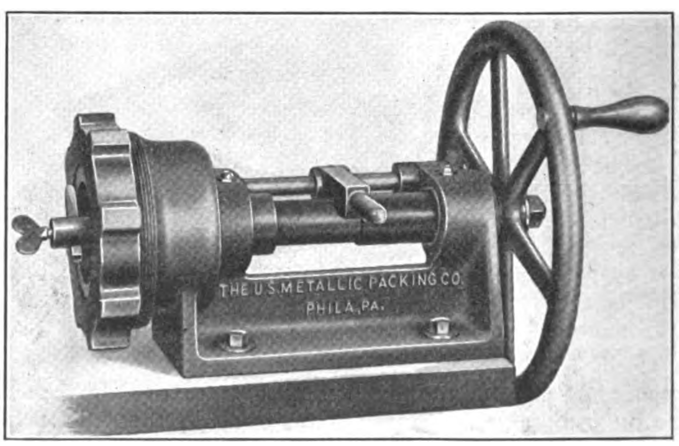
The heating unit shown in the illustration delivers approximately 650,000 B.t.u. an hour, with initial or room and final temperatures of 40 deg. and 111.3 deg., respectively. At initial and final temperatures of 70 and 128 deg., its capacity is approximately 500,000 B.t.u. an hour. The fan operates at 565 r.p.m., delivering 8,000 cu. ft. of air per min. These units can be combined in one assembly containing as many units as desired, depending on the size of the room to be heated.

Hand boring lathe for King packing

THE practice of sending packing rings from the enginehouse to the back shop for reboring is an inefficient and costly one. To facilitate this work the United States Metallic Packing Company, Philadelphia, Pa., has recently placed on the market a hand-operated lathe for boring out King metallic packing.

The lathe is composed of a body with the chuck cast integral. The chuck is machined to accommodate a 5-in. King packing ring and is adjusted to the various sizes of rings by means of reducing bushings. The boring bar is made in one piece with a 3/8-in. square high speed tool bit fitted in one end and which is held in place with a wing set screw. The opposite end of the boring bar is fitted with a large wheel which is rotated by hand by means of a handle that is free to turn on a small spindle. The boring bar revolves in bronze bushings forced in holes which are bored concentric with the chuck. This insures absolute concentricity of the ring.

In the center of the boring bar a reduced threaded portion is engaged by a half nut that gives the boring bar a longitudinal motion when the wheel is revolved. The half nut can be raised to allow the boring bar to be moved by hand for quick return to the original position.



Convenient machine for quickly machining King metallic packing

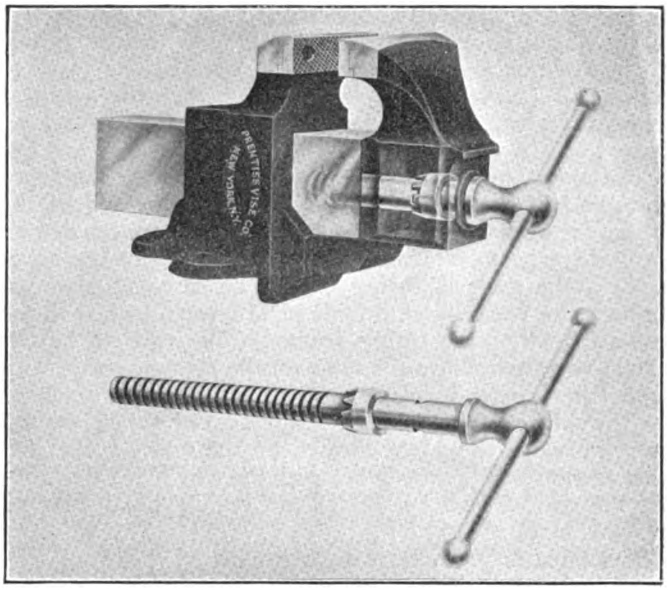
The packing ring is clamped in the chuck by means of a nut that has an internal thread which engages an external thread on the chuck. The nut is drawn up tightly by hand, which is sufficient to clamp the rings. The body of the lathe is drilled to accommodate four bolts or lag screws for fastening it to the end of a bench.

Improved vise screw collar

THE accompanying illustration shows a new collar fastening for vise screws which is a recent improvement made to the vises manufactured by the Prentiss Vise Cmpany, New York. The purpose of this collar is to fasten the screw to the front jaw and draw out this jaw when the screw to the front jaw is turned to open the vise. If the collar or any other device used for fastening the main screw to the front jaw becomes loose, there is lost motion which has to be taken up before the vise is opened or closed. The new collar does not depend on a set screw to hold it in its proper position.

When the screw heads are forged on the main screws, two depressions are also forged on opposite sides of the screw shank. A castellated collar having prongs of varying lengths with prongs of the same length opposite each other are slipped over the screw. Two of these prongs are driven into the depressions in the screw shank making the collar for all practical purposes an integral part of the screw. This arrangement makes it certain that the front jaw will always follow the screw without any noticeable play or lost motion.

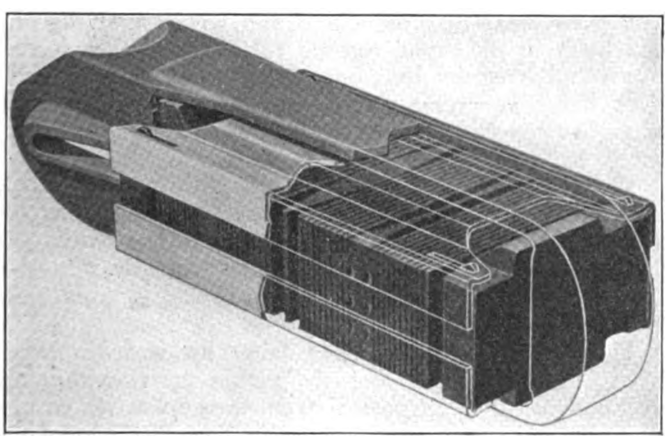
To minimize wear on these parts, all the bearing surfaces are machined. The collar itself is drilled to size to insure a close fit on the screw. Should any wear develop at these points through lack of lubrication and long use, a blow with a hammer on a flat punch placed against the prongs, will cause them to stretch and take up the wear. If this adjustment should not be sufficient, the depressed prongs can be cut off with a chisel and the collar turned around and a longer set of prongs driven in the depressions, thus holding it in a permanent position.



Prentiss vise screw collar designed to prevent lost motion

Improved draft gears for freight cars

THE illustration shows an enclosed type of draft gear made for capacities of 200,000 to 1,000,000 lb. and in standard sizes to fit 18½ in. and 24⅝ in. pockets, and in special sizes to suit special conditions.



Phantom view, showing the construction of the Waugh enclosed draft gear

There are over 4,000 sq. in. of frictional surfaces in addition to the spring capacity on a Standard 29⅛-in. draft gear. Its capacity is controlled by increasing or decreasing the number of plates in each group. This flexibility of design enables a railroad, if desired, to transfer the gear from one car to another and arrange the groups of plates to meet the capacity of the car.

In construction, the draft gear consists of straight spring plates, end followers with convex curved faces, spring end separators with concave curved faces and a convex center separator. The spring plates are oil tempered and the followers and separators are drop forgings and malleable castings.

In operation the groups of spring plates are deflected over the curved faces of the followers and separators which limit the deflection and protect the plates against injury from over solid blows.

The deflection of these plates from their normal straight form is attended by an increasing frictional adhesion of the surfaces, which adds to their cushion capacity and retards the recoil upon the return of the gear to normal position. When fully compressed, the plates in each group take a bearing over their entire area.

As the standard height of the spring plates and operating parts is 6 in., a bottom guide casting and a top guide pressing are used to retain the gear in approximately the vertical center of the standard 9¼ in. pocket and yoke. These guides also retain the gear in alinement regardless of variation in sill spacing. This draft gear is manufactured by the Waugh Equipment Company, Chicago.

High speed metal cut-off saw

THE machine illustrated below was designed by the Hunter Saw & Machine Company, Pittsburgh, Pa., to cut cold metal by means of a high rotative speed circular saw, particularly adapted for tubing and metal sections. The motor and saw blade are mounted on opposite ends of a tilting frame, the machine is driven by a belt from the motor and an idler pulley is located in the frame to give a maximum belt contact on the arbor pulley with a minimum tension. The saw arbor and idler pulley are equipped with S. K. F. self-alining ball bearings in oil-tight dust-proof housings. The belt and saw blades are fully protected by steel guards to conform with safety specifications. A pan is attached to the under side of the table enclosing the saw at its lowest point to catch cuttings. This pan can be dropped and the cuttings removed, which operation requires only a minimum of time.

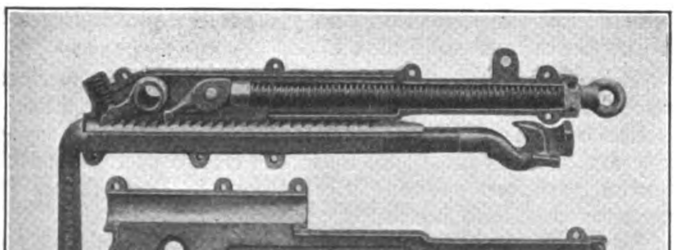
The motor support is provided with adjusting screws to give the belt the desired tension. The motor end of the tilting frame has a cushioned stop and is connected with a spiral spring to return the frame to the height necessary to clear the material being cut. The saw is fed down through the work by an offside hand lever attached to the forward end of the tilting frame. The work to be cut should be raised above the table on the clamping side with supporting strips furnished to prevent it from pinching the saw blade when passing through. For rapid production, the work should be located on the table so that the least section will be in contact with the saw blade throughout the cut. These conditions are readily obtained with this machine.

The table is provided with a graduated quadrant stop that can be set to any angle within the sweep of the saw blade used. This stop is held firmly in position on the table by a bolt moving through T-slots. The material is clamped by a quick-acting eccentric jaw. The machine has a capacity for tubes up to 4 in. in diameter. It is equipped to take care of a saw of 24-in. maximum overall section. It is driven by a 7½-hp. motor with a speed of 1,750 r.p.m. The machine occupies a floor space of 31 in. by 24 in. and can be readily moved if desired.

Hunter saw for cutting metal cold

Automatic slack adjuster for freight cars

WHILE the air brake today is one of the most highly developed and efficient devices used on freight cars, every part from the brake shoes to the brake cylinders must be in accurate adjustment for smooth and efficient braking of the long trains in use today. Varying slack on the different cars in the train caused by wear of brake shoes and wheels and the pins and holes in the brake rigging result in different piston travel and irregular braking action throughout the train. This irregular braking action is the principal cause of break-in-twos and damage to cars and lading caused by rough handling.

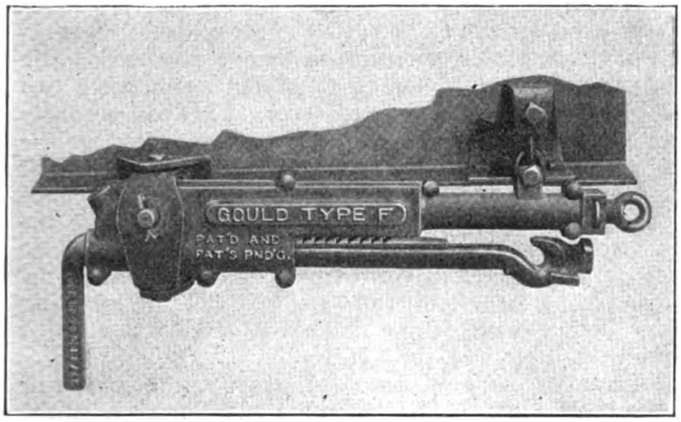


The contained parts of the Gould automatic brake slack adjuster

The Gould Coupler Company, New York, has spent a number of years in the development of a simple and efficient device for freight equipment and The Symington Company, Rochester, N. Y., now presents the result of this study and development in the Type F freight slack adjuster.

This adjuster automatically takes up wear in shoes, wheels, pins, etc., keeping the piston travel within approximately ½ in. of normal from the application of new shoes until they are worn out. When replacement of one or more shoes is necessary, the adjuster may be manually set back for this purpose, and upon the next application of the air, the device is automatically brought into proper adjustment. It is not necessary for the maintenance gang to make any calculations to determine the correct setting of the device as it is not possible to set it improperly.

This adjuster takes the place of the usual dead lever stop. It is attached to the bottom flange of one center sill by two forged brackets designed to allow the necessary flexibility so that the adjuster will accommodate itself to



A slack adjuster for freight cars which takes the place of usual dead lever stop

all normal movement of the dead lever on straight and curved track.

The adjuster consists of a malleable iron housing which serves as a guide for a cylindrical holding rod, the latter being flexibly connected to the dead lever. This holding rod is itself held in position by a sliding rack strip which in turn is held by a pawl or dog. Mounted in the casing above the holding rod is an adjusting rod having a dog or pawl also engaging the holding rod rack strip and held in its normal position by the spring which encircles the adjusting rod. Attached to the eye at the rear of the adjusting rod is a connection which passes under the body bolster and is slidably attached to the top connection or pull rod of the brake rigging just beyond the live lever. An adjustable stop clamped to the top connection or pull rod actuates the adjusting rod as soon as any wear has developed or as soon as the cylinder push rod moves more than the predetermined amount. Assuming wear to have taken place, an application of the brakes moves the adjusting rod so that the movable pawl picks up one tooth on the holding rod rack strip. On the release of the brakes the spring returns the adjusting rod to its normal position carrying the holding rod with it and the holding rod is maintained in its new position by its engaging pawl. This operation is repeated as soon as additional wear amounts to the equivalent of one tooth space on the ratchet. In effect, the device is a dead lever stop with a large number of adjusting holes which automatically changes the position of the dead lever pin until the shoes are worn out.

Portable sanding machine for car repair work

The usual method of finishing metal parts used on passenger cars is by hand filing and buffing. The Carborundum Company, Niagara Falls, N. Y., have placed on the market a portable sanding machine which takes the place of the hand method of finishing. This machine grinds away the metal with a special flexible abrasive disc driven by a motor through a flexible shaft. The disc is coated with Aloxite grains, a hard, sharp and tough abrasive or grinding material manufactured by the Carborundum Company.

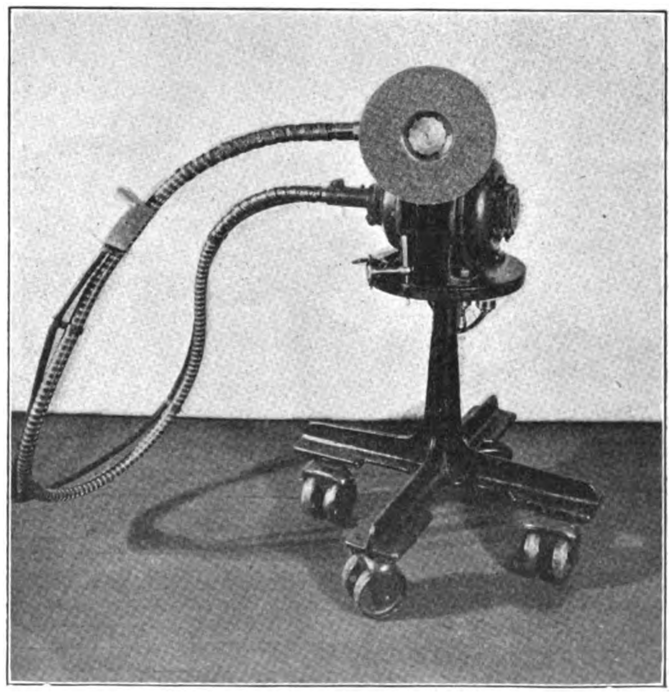
The motor is mounted on a rigid cast iron pedestal, 24 in. high supporting a swivel table providing for a swing of the motor half-way around, or an arc of 180 deg. This feature adds greatly to the adaptability of the unit to any required position during the continuous grinding operations. The pedestal is supported by four substantial double castors, permitting ease of movement and travel, without danger of upsetting. A holder mounted on the table provides a secure resting place for the machine head when not in use.

Each machine is equipped with a one-horsepower motor built to such specifications as may be required to meet the power conditions of the user. The flexible shaft which drives the grinder head is of the most modern and approved type, especially adapted to meet heavy duty conditions. The main castings of the grinding head are of aluminum to insure lightness plus requisite strength and durability.

The assembly shafts and spindles are of steel, supported in ball bearings, reducing friction to a minimum. Heat treated, specially tempered steel mitre gears running in an oil-tight chamber packed with grease provide the angular drive from the flexible shaft. Ample facilities are arranged for the proper lubrication of all moving parts.

The grinding head is designed to be perfectly balanced and the driving mechanism is so planned and constructed as to eliminate vibration. The head is provided with two handles which are located to insure accurate control and convenience in operation.

The Aloxite grains with which the discs are coated



Flexibility of control and operation are features of the carborundum portable sanding machine

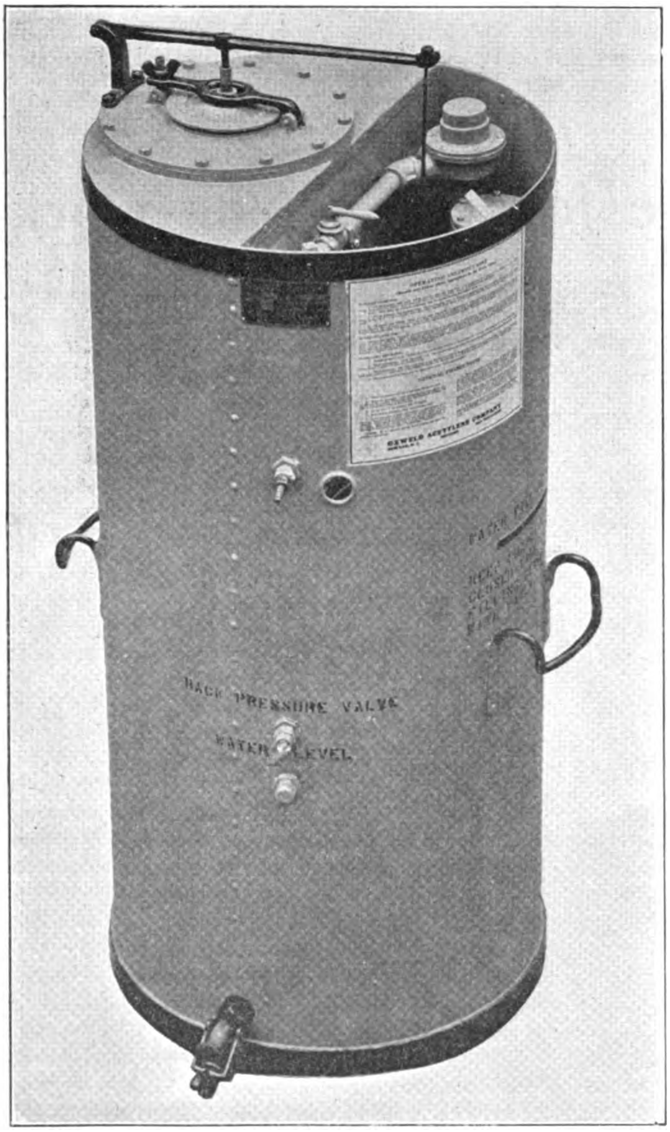
are uniformly graded and are coated on the discs in such a way as to allow for a free cutting action. There is a definite clearance between the grains so that every grain

has full cutting capacity. The grains are coated on a strong, durable backing of cloth drills. This cloth-backed disc is then securely fixed to a special fibre board disc with a moulded, counter-sunk center provided with six pin holes which locate over the pins in the special lock nut that holds the disc securely to the head. These discs are furnished in a standard size of 9¼ in. in diameter.

Flexibility is another important feature in connection with the discs and the grinding head. Evenly supporting the disc is a flexible and compressible pad which yields to the slightest pressure, thus conforming to work projections. This feature together with the flexibility of the discs itself permits the disc to conform readily to mouldings, beadings, sharp curves and contours, even under light pressure.

Portable acetylene generator

A SMALL generator for producing acetylene at low pressure for welding and cutting has recently been developed by the Oxweld Acetylene Company, New York City. The generator, which takes 35 lb. of carbide at one charge, can be transported readily from place to place, thus providing a portable supply of generated acetylene gas. When empty, the generator weighs only 210 lb.



Oxweld portable, low pressure, acetylene generator

A new principle of feed control is used which might be called a "heavier-than-water" float. A vertical partition, extending nearly to the bottom into a water seal, divides the generator shell. One side is gas tight and contains the carbide hopper at the top. The upper part of the other side contains gas regulating and protective devices, and an automatic carbide feed control. Generation of the first acetylene causes water to rise on this side of the partition high enough to all but submerge a pan full of water, hung to a control lever. This pan normally acts as a weight acting counter to a spring, but as the water rises about it, its apparent weight is diminished and the carbide hopper valve is closed by the action of the spring. As acetylene is drawn off, water rises in the gas compartment and correspondingly lowers under the float. This relieves some of the buoyancy under the water pan, which, gathering weight with the receding water, depresses the spring and allows a small amount of carbide to drop into the generator.

Because of its low center of gravity, the generator rights itself when tilted at an angle of 30 deg. It works perfectly at an inclination of upwards of 10 deg. No adverse effects result if a generator, while in operation, is knocked over. Nearly all fittings are enclosed in the cylindrical shell and there is little, if anything, projecting which may be injured by a fall on a concrete pavement.

Ohio universal and tool grinder

A NO. 2-L universal and tool grinder intended primarily for use in railroad and automobile shops for grinding reamers, boring bars, taps and similar tools, has been developed by the Oesterlein Machine Company, Cincinnati, Ohio. The machine will take work up to 30 in. between centers and has a 9-in. swing with a 7½-in. vertical movement. It is of the milling machine type of construction.

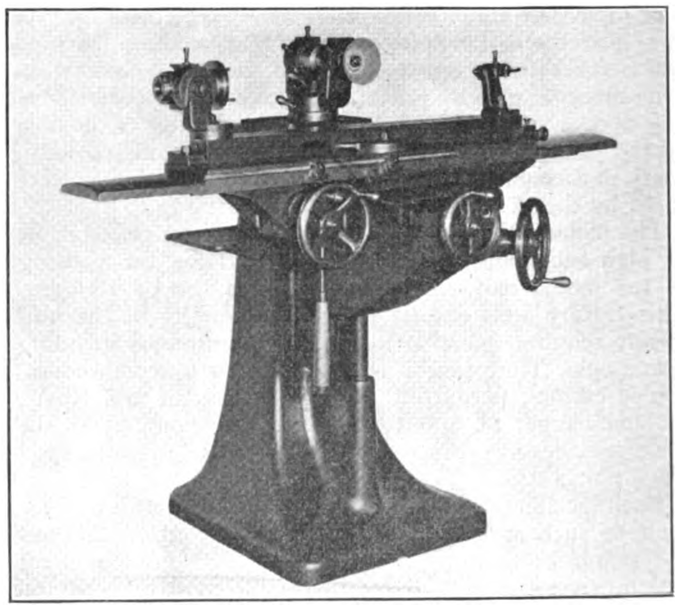


Table of the Oesterlein tool grinder may be reciprocated by means of a ball-bearing lever feed

The table reciprocation may be obtained through a handwheel, in which case two gear ratios are available. In addition, a ball-bearing lever feed is provided that may be engaged at any point to permit the operator to use either his right or left hand for reciprocating the table. This lever feed has also been added to the Nos. 2 and 3 grinders built by this company.

General News

As a part of its expense-reduction program, the Pennsylvania has ordered the abandonment of the heavy repair shop on the Marion division at Logansport, Ind. A large number of the 800 men affected by this order have been offered work at either Columbus, Ohio, or Fort Wayne, Ind., where the heavy repair work will be done in the future.

Ninety employees of the Pennsylvania System were retired from active duty on August 1, under the company's pension plan, and placed upon the "Roll of Honor." Seven of those have been in the employ of the road for 50 years or more each, while 55 have had records of 40 years' service or more. Since the establishment of the Pennsylvania's pension plan, on January 1, 1900, a total of 18,374 employees have been retired under its provisions; of whom 8,262 are still living.

Court news

Federal Jurisdiction Exclusive as to Safety of Locomotives.—The federal district court for northern Georgia holds that since Congress has provided for making regulations for the safety of locomotives, this field is exclusively occupied by federal legislation. The carriers have proposed and the commission has not required a rule of inspection providing for automatic firebox doors. Therefore, Georgia Laws of 1924, p. 173, requiring locomotives to be equipped with such doors is held invalid as to locomotives engaged in interstate commerce.—Atlantic Coast Line v. Napier, 2 F. (2nd) 891.

New Santa Fe cars make successful trial trip

The Atchison, Topeka & Santa Fe has just purchased from the Pullman Company and placed in service a dining car and a club lounge car which embody a number of revolutionary changes in design. These cars, which are intended to be operated as a unit, have made a trial trip from Chicago to Los Angeles and return in the California Limited. They depart from conventional design primarily in their interior arrangement which has been planned with a particular view to increasing the efficiency of dining car service. These cars are still considered in the experimental stage and their operation is being watched closely. Patents have been granted to Byron S. Harvey, of the Harvey System, on a number of features of the diner.

Train control installations

The Interstate Commerce Commission has postponed from July 1 to February 1, 1926, the date for fulfilment by the Pere Marquette of the commission's order requiring an installation of automatic train control.

By an order dated July 21 the Illinois Central has been authorized to install automatic train control on its road between Waterloo, Iowa, and Fort Dodge, 100 miles, instead of installing on a division between Chicago and Memphis as was called for by the commission's order of January 14, 1924. This action was taken by the commission on condition that the order shall not result in extending the time within which the order shall be complied with, namely February 1, 1926. The road also must agree that the amendment does not entitle it to claim, in court or elsewhere, any extension of time beyond February 1, 1926.

Cost of locomotive fuel

The cost of fuel coal to the railroads showed a further reduction in April as compared with last year and the earlier months of this year, according to the monthly statement issued by the Interstate Commerce Commission. On the other hand, the cost of fuel oil showed an increase. The average cost of fuel for road locomotives in freight and passenger train service (charged to operating expenses) for Class I steam railways in April was $2.79 a ton, as compared with $3.19 last April and $2.81 for four months of this year. There was also a reduction in the number of tons used, and the total cost for the month was $20,532,551. The average cost of fuel oil was 3.29 cents per gallon, as compared with 2.80 cents last April and 3.11 cents for four months. The total cost of coal and fuel oil for four months this year was $112,885,814, as compared with $132,244,549 for the corresponding period of last year.

American Locomotive Company to build Whaley constant pressure oil engine

The American Locomotive Company has acquired the exclusive license for the use of the Whaley constant pressure oil engine on rails in the western hemisphere. An engine of this type has recently been built by the Sun Shipbuilding & Dry Dock Company, Chester, Pa. It departs in one essential respect from all other present internal combustion engines in that a piston valve driven by the valve motion of the type commonly used in steam engineering practice opens the cylinder clearance into communication with a receiver of large capacity relative to the clearance, the valve opening synchronizing with the period of the fuel injection. Through this feature it is claimed that the combustion pressure does not rise above the compression pressure, and that an indicator card similar to that of a steam engine is produced. The limiting of the maximum pressure is expected to make possible the production of an engine which will weigh less than 100 lb. per horsepower. The engine just completed is a single acting, four-cylinder, two-cycle machine designed to develop 750 hp.

Meetings and Conventions

American Welding Society

The fall meeting of the American Welding Society will be held on October 21, 22 and 23 at the Massachusetts Institute of Technology, Cambridge, Mass. Exhibits of welding and welded products are to be featured at this meeting and actual demonstrations of welding and cutting will start each morning at 9 a. m. and last until 5 p. m. Five technical sessions are scheduled, at which papers on thermit welding, gas welding of power plant piping, industrial applications of arc welding and economies effected through its use, selection of materials for welding, and spot welding of automobile bodies will be presented.

Machine tool exhibition at New Haven, Conn.

The fifth annual machine tool exhibition will be held in New Haven, Conn., September 8 to 11, inclusive, in conjunction with the sessions of the Machine Shop Practice Division of the American Society of Mechanical Engineers. A diversified number of addresses, papers and discussions of great significance to men concerned with machine tool work of any description, are included in the three-day program. The following papers and the time during which they will be presented should be of particular interest to railroad machine shop men.

Centerless grinding, Wednesday afternoon; cylindrical precision lapping and high speed cutting of brass, Thursday afternoon; round table dinner discussion, Thursday evening of four subjects—namely, inspection methods and precision measurements, power press work, production milling and shop training methods, and Friday afternoon, shop training methods.

Over 100 manufacturers will present the latest developments in the machine tool and accessory equipment showing the advancement made in the machine tool industry during the past year. The exhibit will be held at Mason Laboratory, Sheffield Scientific School of Yale University.

General foremen to meet in September

The twentieth annual convention of the International Railway General Foremen's Association will be held at the Hotel Sherman, Chicago, September 8 to 11. Among the interesting topics to be considered are automatic train control; supervision of repairs of special appliances such as boosters, reverse gears, etc.; straight line or spot system of car repairs and routing system to increase locomotive shop output. An additional topic which promises to be of unusual value and provoke a large amount of discussion is entitled "What Can the General Foreman Contribute to Obtain More Ton Miles per Shop Man Hour?"

Program for the Regional meeting of the A. S. M. E. elects officers for 1926

The American Society of Mechanical Engineers will hold a regional meeting on October 5, 6, 7 at Altoona, Pa. As the technical sessions will relate to transportation problems, a more appropriate surrounding for the meeting could not have been selected as the large manufacturing and repair shops of the Pennsylvania System are located at Altoona. Those attending the convention will be favored with the opportunity of visiting the Altoona shops, particularly the new $2,000,000 locomotive repair shop which has been completed within the last two years.

The following program offers to those attending an opportunity of not only seeing the points of interest in the vicinity of Altoona, but of listening to a number of speakers well-known in the railroad world.

Monday, October 5

Morning and afternoon: Meeting of Council of The American Society of Mechanical Engineers.
Afternoon: Miscellaneous entertainment, such as golf and automobile trips to points of interest.
Evening: Dr. William F. Durand, president, A. S. M. E., presiding.
Conferment of Honorary Membership in The American Society of Mechanical Engineers on General William Wallace Atterbury, vice-president of the Pennsylvania Railroad System.

Tuesday, October 6

Morning: Technical Session.
Afternoon: Trip by special train to Old Portage where party will detrain to see the Old Portage where the incline planes were located by which passengers by canal were taken over the mountains. Special train will return by the Horse-Shoe Curve to Altoona.
Evening: Entertainment in Altoona.

Wednesday, October 7

Morning: Technical Session.
Afternoon: Visit to Altoona shops. One of the features will be the operation on the test plant of the first electric locomotive ever tested on it.

Technical Sessions

The entire program for the technical sessions has not been completed, but the following speakers have accepted:
Samuel Rea, president, Pennsylvania Railroad, on American Transportation.
Lawford H. Fry, metallurgical engineer, Standard Steel Work Co., Burnham, Pa., on Influence of the Altoona Test Plant on Steam Locomotive Development.
Samuel P. Bush, president, Buckeye Steel Castings Co., on Engineering Development in the Industries Generally to meet Railroad Wants.
A. J. County, of the Pennsylvania Railroad, on the Growth of a Great Transportation System.

Elaborate arrangements are being made to take care of the ladies and an active committee will be in charge of a series of interesting events for them.

Master Blacksmiths' Supply Men's Association elects officers for 1926

A total of thirteen railway supply companies had exhibits of their products at the twenty-ninth annual convention of the International Railroad Master Blacksmiths' Association, held August 18, 19 and 20, at Cleveland, Ohio. The annual meeting of the Supply Men's Association was held at the Hotel Winton, August 20, at which time the following officers were elected: James A. Murray, Ajax Manufacturing Company, president; A. N. Lucas, The Oxweld Railroad Service Company, vice-president, and Edwin T. Jackman, Firth-Sterling Company, secretary-treasurer. The following is a list of the exhibitors with their representatives:

Ajax Manufacturing Company, Cleveland, Ohio.—Forgings, model of board drop hammer, model of 4-in. Ajax upsetting forging machine, and literature. Represented by J. R. Blakeslee, J. A. Murray, A. L. Guilford, G. Fistoe and W. W. Criley.

Anti-Borax Compound Company, Ft. Wayne, Ind.—Welding compound and literature. Represented by Charles O. Kahre.

Colonial Steel Company, Pittsburgh, Pa.—Crucible for melting steel, specimens of hardened fractures, raw alloy material used in making high-speed steel, specimens of alloy and carbon tool steel fractures, and literature. Represented by F. L. Stevenson.

Crucible Steel Company of America, Pittsburgh, Pa.—Forging machine gripper dies, taps, high-speed steel and Sanderson special tool steel. Represented by F. Baskerfield, A. E. Jones and W. M. Stevenson.

Firth-Sterling Steel Company, McKeesport, Pa.—C. Y. W. bolt and rivet dies, special rivet buster. Represented by Edwin T. Jackman, Willard C. Royce, Thomas A. Larecey, and William A. Nungester.

E. F. Houghton & Co., Philadelphia, Pa.—Railway springs, quenching oils, "draw-temp", hydrocarbonate base black, "quick light A", literature. Represented by Wilbur Wriglet, W. A. Fletcher and J. E. Burns, Jr.

Metal & Thermit Corporation, New York.—Specimens of thermit welding, literature. Represented by Henry D. Kelly and W. H. Moore.

National Machinery Company, Tiffin, Ohio.—Literature. Represented by E. R. Frost, Karl L. Ernst, H. E. Lott and F. J. Mawey.

Oxweld Railroad Service Company, Chicago.—Gas cylinder gages and torches. Represented by William A. Champieux, A. N. Lucas, William Jones, J. W. Boyd and J. W. O'Neil.

Locomotives installed and retired

	Installed during month	Aggregate tractive effort	Retired during month	Aggregate tractive effort	Owned at end of month	Aggregate tractive effort
January, 1925	167	7,455,971	213	6,242,079	64,824	2,590,525,478
February	125	6,233,494	169	5,118,878	64,779	2,591,618,849
March	138	6,249,721	170	4,888,933	64,747	2,592,979,637
April	171	7,498,252	409	13,126,135	64,509	2,587,347,354
May	147	7,930,840	172	5,329,461	64,484	2,589,912,779
June	179	9,746,100	224	8,296,659	64,435	2,591,286,720
July	...	....	...	....	......	....
Total for 6 months	927	....	...	....	......	....

Figures as to installations and retirements prepared by Car Service Division, A. R. A., published in Form C. S. 56A-1. Figures cover only those roads reporting to the Car Service Division. They include equipment received from builders and railroad shops. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

Locomotive repair situation

Date, 1924	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No. req. running repairs	Per cent	Total req. repairs	Per cent
February 1	64,377	53,586	4,116	5,919	9.2	4,872	7.6	10,791	16.8
April 1	64,363	52,805	4,648	6,128	9.5	5,430	8.4	11,558	17.9
July 1	64,416	53,382	7,117	6,035	9.4	4,999	7.7	11,034	17.1
October 1	64,538	53,209	5,424	6,175	9.6	5,154	8.0	11,329	17.6
January 1, 1925	64,384	53,118	4,849	5,927	9.2	5,339	8.3	11,266	17.5
February 1	64,308	52,994	4,220	6,143	9.6	5,171	8.0	11,314	17.6
March 1	64,255	52,851	4,988	6,217	9.7	5,187	8.0	11,404	17.7
April 1	64,230	52,619	6,241	6,345	9.9	5,266	8.2	11,611	18.1
May 1	64,034	52,933	6,697	6,082	9.5	5,019	7.8	11,101	17.3
June 1	63,976	53,074	6,618	5,916	9.2	4,986	7.8	10,902	17.0
July 1	63,942	53,025	6,600	5,832	9.1	5,085	8.0	10,917	17.1

Data from Car Service Division reports.

Freight car repair situation

1924	Number freight cars on line	Cars awaiting repairs: Heavy	Light	Total	Per cent of cars awaiting repairs
January 1	2,279,363	118,653	39,522	158,175	6.9
April 1	2,274,750	125,932	46,815	172,747	7.6
July 1	2,279,826	144,912	49,957	194,869	8.5
October 1	2,304,020	157,455	48,589	206,044	8.9
January 1, 1925	2,293,487	143,962	47,017	190,979	8.3
February 1	2,305,520	139,056	47,483	186,539	8.1
March 1	2,313,092	141,192	43,855	185,047	8.0
April 1	2,315,732	143,329	43,088	186,417	8.1
May 1	2,316,561	144,047	45,467	189,514	8.2
June	2,320,261	146,998	48,988	195,986	8.4
July	2,326,734	150,530	47,938	198,468	8.5

Month	Cars repaired: Heavy	Light	Total
December	87,758	2,073,280	2,161,038
March	77,365	2,213,158	2,290,523
June	70,480	1,888,899	1,959,379
September	74,295	1,372,277	1,446,572
December	66,615	1,288,635	1,355,250
January, 1925	69,084	1,358,308	1,427,392
February	66,283	1,313,088	1,379,371
March	71,072	1,348,078	1,419,150
April	69,631	1,290,943	1,360,574
May	65,651	1,276,826	1,342,477
June	71,789	1,296,558	1,368,347

Data from Car Service Division Reports.

Pilot Packing Company, Chicago.—Packing, Literature. Represented by W. W. Bacon.

Railway Journal, Chicago.—Copies of publication. Represented by E. C. Cook.

Railway Mechanical Engineer, New York.—Copies of publication. Represented by Marion B. Richardson.

Rockwell, W. S., Company, New York.—High and low pressure burners and blast gates, fuel oil appliances, forging and heat treating furnaces, literature. Represented by C. P. Cogswell, D. M. Powers and R. M. Atwater.

Ulster Iron Works, Dover, N. J.—Special staybolt iron, engine bolt iron, drilled hollow staybolts, hammered iron billets. Represented by C. F. Barton, E. W. Kavanaugh, J. C. Campbell and L. E. Hasman.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association, Division V.—Mechanical—V. R. Hawthorne, 431 South Dearborn St., Chicago.
Division V.—Equipment Painting Section.—V. R. Hawthorne, Chicago. Next meeting September 15, 16 and 17, 1925, at St. Paul Hotel, St. Paul, Minn.
Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet Ave., Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Regional meeting October 5-7, at Altoona, Pa. Technical program on transportation problems. Railroad Division. A. F. Steubing. Bradford Corp., 25 West Forty-third St., New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention week of September 14, 1925, Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting, October 27 to 30, inclusive, Hotel Sherman, Chicago.

Canadian Railway Club.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Car Foremen's Club of Los Angeles.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club building, Los Angeles, Cal.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, Hotel Statler, Buffalo, N. Y. Next meeting September 10. A paper on The Lima 2-8-4 Locomotive will be presented by H. W. Snyder, mechanical engineer, Lima Locomotive Works.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Annual convention, Hotel Sherman, Chicago, September 22-24.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November. Next meeting September 8. Humorist talk on general railroading by Dusty Miller. Dinner party and address by Mr. Miller.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month except July, August and September, at Hotel Cleveland, Public Square, Cleveland.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. B. Hutchinson, 1809 Capitol Ave., Omaha, Neb. Next meeting May 11-14, 1926, Hotel Sherman, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W Wabash Ave., Winona, Minn. Annual convention September 8-11, Hotel Sherman, Chicago.

Master Boiler Makers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass.

New York Railroad Club.—H. D. Vought 26 Cortlandt St., New York. Meeting third Friday each month, except June, July and August, at 29 West Thirty-ninth St., New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 625 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

Railway Club of Greenville.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern Railway shops, Atlanta, Ga.

Travelling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting, September 15-18, 1925, Chicago.

Western Railway Club.—Bruce V. Crandall, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

The General American Tank Car Corporation has removed its Los Angeles office from the Pacific Finance building to the Bartlett building.

The Union Tank Car Company is constructing repair shops, including a foundry, a machine shop, a power plant and a wheel shop, at Whiting, Ind.

John P. Bourke, eastern sales manager of the Ewald Iron Company, Louisville, Ky., has been elected a vice-president, with office at 33 West Forty-second street, New York City.

The R. K. LeBlond Machine Tool Company, Cincinnati, Ohio, has appointed the Federal Machinery Sales Company, Chicago, its sales representative for Chicago and adjoining territory.

Robert L. Nutt, Jr., Norfolk, Va., now represents Robert H. Blackall of Pittsburgh and New York for the sale of the Lawson pipe wrench to railroads in Norfolk and adjacent territory.

Arthur Jackson, 32 Glenholme avenue, Toronto, Ontario, has been appointed sales representative for Ontario and Eastern Canada of the Gibb Welding Machines Company, Bay City, Mich.

Harold Bates has joined the sales department of the Bridgeport Brass Company, Bridgeport, Conn. He will be engaged with matters pertaining particularly to sales organization and research.

Percy M. Brotherhood, formerly first vice-president of Manning, Maxwell & Moore, Inc., has opened an office at 25 Church street, New York City specializing in machine tools and specialties.

The Ohio Locomotive Crane Company, Bucyrus, Ohio, has purchased the Bucyrus plant of the Ohio Steel Foundries, Lima, Ohio, and will remodel the plant for the production of gray iron castings.

The Tennessee Engineering & Sales Company, 510 Burwell building, Knoxville, Tenn., has been appointed agent in part of Tennessee and Kentucky within a working radius of the city of Knoxville, for the Roller-Smith Company, New York.

The Cummings Car & Coach Company has been incorporated, with headquarters at 111 W. Monroe street, Chicago, to manufacture railway appliances. The company has a capital of $200,000, and has issued 1,000 shares of no par value stock. Walter J. Cummings, O. N. Hebner and John T. Giblin are the incorporators.

William J. Miskella has opened an office and laboratory at 1164 West Twenty-second street, Chicago, where he will specialize as a consulting engineer on lacquer, japan and enamel finishing problems. Mr. Miskella was formerly for many years branch manager of the De Vilbiss Manufacturing Company and president of the Lamberson Japanning Company.

The Air Reduction Sales Company, New York City, has purchased the assets and assumed the liabilities of the Gas Tank Recharging Company, incorporated in 1913. The Gas Tank Recharging Company owned and operated acetylene plants at Milwaukee, Wis., and Bettendorf, Iowa; and a carbide plant at Keokuk, Iowa, where they manufactured Sun-Lite brand carbide.

The Lenoir Car Works, Lenoir City, Tenn., has placed a contract with the Converse Bridge & Steel Company, Chattanooga, Tenn., for the construction of car erecting and steel fabricating shops 800 ft. by 125 ft. to take the place of a structure recently burned. The new building, which will be of steel construction, will be completed in 90 days and will be equipped with new machinery.

E. E. Goodwillie, district sales agent of the Bethlehem Steel Company, with headquarters at Chicago, has been appointed steel sales representative on the Pacific Coast, with headquarters in San Francisco, Cal., to succeed Leigh B. Morris, resigned. John F. Hennessy, district sales agent, with headquarters at Cincinnati, Ohio, has been transferred to Chicago, to succeed Mr. Goodwillie.

Brownrigg L. Norton, for the past two years representative at New York of the Western Railway Equipment Company and the Railway Devices Company, of St. Louis, Mo., has resigned the above representation to become sales agent of the Scullin Steel

Company, St. Louis. Mr. Norton's headquarters will be in the New York office of the company at Room 2050, Grand Central Terminal, New York.

The Haynes Stellite Company, New York, manufacturers of metal cutting tools has completed concentration of the company's activities at its plant at Kokomo, Ind. All service in connection with its products will hereafter be extended direct from the plant. The headquarters for administration, sales and engineering activities will be at Kokomo, conducted under the direction of C. G. Chisholm, general manager.

The More-Jones Brass & Metal Company is completing the erection at St. Louis, Mo., of a modern and large plant which will be devoted to the production of brass and bronze castings. The plant will consist of a foundry and machine shop which will provide a total floor area of 157,000 sq. ft. The railroad facilities for the plant will consist of a double spur track for loading and unloading 10 cars and a yard capacity of 20 cars.

The Prentiss Vise Company, New York, has bought the Henry Cheney Hammer Corporation, of Little Falls, N. Y., complete, and will continue to operate the plant at Little Falls with the same personnel that has been there for some time. The Cheney hammers will in future be sold through the Prentiss Vise Company, and the hammer plant will be operated as the Cheney Hammer division of the Prentiss Vise Company.

William McConway, president of the McConway & Torley Company, died on July 28, in St. Francis hospital, Pittsburgh, Pa. Mr. McConway was born in Ireland on February 14, 1842. He came to the United States in 1849 and attended the public schools until he was 12, when he went to work with the Novelty Iron Works. Six months later he entered the service of Olhausen & Crawford, manufacturers of malleable iron castings, remaining with that company until September, 1861, when he entered the United States Army as a private and served through the Civil War; during this service he was promoted to sergeant-major, and in July, 1863, was commissioned a second lieutenant. In September, 1864, he returned to civil life and resumed his employment with Olhausen & Crawford, in 1866 becoming a junior partner of this firm. In 1869 he organized the present business under the firm name of Lewis & Co. and became its general manager. The following year the name was changed to the McConway & Torley Company, and in 1892 the firm was incorporated. Mr. McConway was a pioneer in the development of the automatic coupler. He had served as a director of numerous corporations including that of the Westinghouse Electric & Manufacturing Company. He was also a trustee of the Carnegie Institute and the Carnegie Institute of Technology.

William McConway

The Dearborn Chemical Company, Chicago, is constructing a concrete and brick building as an extension to its plant which will add 10,000 sq. ft. of floor space. New power plant equipment will consist of return tubular boilers, each equipped with automatic feed stokers, and overhead concrete coal bunkers of 150-ton capacity to be filled by a conveyor which will also handle the ashes. The cost of the new plant will be in the neighborhood of $150,000.

The Simplex Semimetallic Packing Company, Pittsburgh, Pa., has acquired all patents, patent rights, trade marks, etc., of the Mason Semi Metallic Packing Company, of Pittsburgh, manufacturers of air pump and piston packings. The Simplex company has discontinued the office of the Mason Packing Company which was located in the Renshaw building and has opened offices in the Oliver building, Pittsburgh, where the business of the company will be conducted.

H. G. Mastin has been appointed representative in the sales department of the Locomotive Stoker Company, eastern district, with headquarters at New York City. Mr. Mastin was born in December, 1887, at Millbrook, N. Y. He served from 1906 to 1918 on the New York, Ontario & Western consecutively as locomotive fireman, traveling fireman and assistant road foreman of engines, and since October, 1918, as mechanical expert for the Locomotive Stoker Company.

The General American Tank Car Corporation, Chicago, has made the following appointments in its tank car sales department: R. J. Sharpe, general western sales manager, with headquarters at Tulsa, Okla.; M. A. Sticelber, sales representative, Tulsa, Okla.; Bennett Epstein, general eastern sales manager, New York City; R. T. Musser, Pacific Coast sales manager, with headquarters at Los Angeles and San Francisco, Cal., and Z. R. Simon, southern sales manager, New Orleans, La.

W. H. Davis, service engineer of the Universal Packing & Service Company, Chicago, has been promoted to general sales manager, with headquarters at Chicago. R. C. Blakslee, of the testing department of the Chicago, Rock Island & Pacific, with headquarters at Silvis, Ill., has resigned to become a service engineer for the Universal Packing & Service Company. T. P. Williams and J. D. Herr, formerly associated with the National Waste Company at Philadelphia, and W. M. Gibbs, formerly employed by the same company at Chicago, have been appointed service engineers of the Universal Packing & Service Company.

The Bird-Archer Company has opened a new plant in Chicago for the manufacture of boiler water treatment chemicals. The building is of brick and steel construction and with ground owned and available will permit of a 500 per cent expansion. The locomotive anti-foaming compound department is capable with present equipment of turning out 30,000 lb. per day while the department allocated to the manufacture of locomotive anti-scaling and anti-pitting compounds in solid form has a capacity of approximately 20,000 lb. per day. Arrangements for a branch laboratory in connection with the new plant will soon be consummated.

E. J. Tierney, in the service of the mechanical engineer's office of the Missouri Pacific, and George P. Hoffman, general car foreman of the Baltimore & Ohio, at Baltimore, Md., have been appointed district sales managers of the Grip Nut Company, Chicago. Mr. Tierney was born at Attica, N. Y., on October 20, 1888, and was educated in the schools at Attica and Scranton. He entered the service of the Erie Railroad as a water boy and in 1902 went to the Missouri-Kansas-Texas as a machinist apprentice. In 1906 he went to the Missouri Pacific as a machinist. He subsequently served in the same capacity on the Colorado & Southern; Southern Pacific; Chicago, Burlington & Quincy; Galveston, Harrisburg & San Antonio and then returned to the Missouri Pacific as shop draftsman. In 1908 he returned to the Missouri-Kansas-Texas as mechanical draftsman, and was promoted in 1913 to chief draftsman and general inspector of the Missouri-Kansas-Texas lines, which position he left to join the United States Army in France, where he served as a second lieutenant in the engineering corps. assigned to duty in Russia on the Trans-Siberian railroad. He subsequently returned to France where he served in the army for one and one-half years. After his discharge from the army, he returned to the Missouri-Kansas-Texas. In 1920 he was appointed mechanical engineer of the Louisiana & Arkansas, and two years later served in the same capacity with the Midland Valley. He subsequently resigned to return to the Missouri Pacific as inspector, gang foreman and general draftsman, which position he held until his appointment with the Grip Nut Company, as above noted. Mr. Tierney will be located in Chicago. Mr. Hoffman was born at Meyersdale, Pa., on June 28, 1889, and was educated in the public schools and the Tri-State business college in Cumberland, Md. On September 1, 1907, he entered the service of the Baltimore & Ohio as an apprentice in the car department, and in 1912, was appointed supervisor, which position he held until he entered the United States Army, and served two years in the World War with the army in France. He entered the service as a private and was promoted to a commission. After receiving his discharge he returned to America and remained in government service as supervisor of car repairs with the Railroad Administration until he was reappointed general car foreman of the Baltimore & Ohio at Baltimore, which position he resigned to enter the service of the Grip Nut Company. Mr. Hoffman in his new position will be located in the East.

Trade Publications

Gear catalogue.—Standard stock gear catalogue No. 42, illustrating spur gears, bevels, mitres, internal gears, worms, worm gears and spiral gears, has been issued by the Charles Bond Company, Philadelphia, Pa.

Pipe threading machinery.—The Landis Machine Company, Inc., Waynesboro, Pa., has issued catalogue No. 29 descriptive and illustrative of its pipe threading and cutting machines, pipe and nipple threading machines and chaser grinder.

Carbide lights.—Portable carbide lights for night construction are described in a 26-page booklet issued by the Alexander Milburn Company, Baltimore, Md. These lights are particularly suited for contractors, railway mines and quarries.

Galvanum paint.—A color card and a folder descriptive of Galvanum paint have been issued by the Goheen Corporation of New Jersey, Newark, N. J. This paint is applied directly to galvanized iron without the aid of an acid wash or primer of any sort, and no weathering of the metal is necessary.

Vacuum recorders.—Vacuum recorders which operate on the mercury column principle and employ no moving parts, springs or diaphragms, are covered in Bulletin No. 140 recently issued by the Uehling Instrument Company, Paterson, N. J. Full size reproductions of sections of typical vacuum charts show the legibility of this instrument.

Oxwelding and cutting.—"Precautions and safe practices" is the title of a 16-page brochure which has recently been issued by the Oxweld Acetylene Company, Long Island City. This pamphlet has been prepared to provide a brief and practical list of "do's and don't's" so men may understand the precautions and care which are necessary to the safe and economical use of the oxy-acetylene process.

Oxyacetylene process.—"Answers to questions about the oxy-acetylene process," a recent publication of the Air Reduction Sales Company, New York, is intended to supply in convenient pocket form some of the information often requested on the principles of the oxyacetylene process, oxygen, care of oxygen cylinders, acetylene, care of acetylene cylinders, equipment, welding, cutting and the company.

Cranes and foundry equipment.—A black leather binder made up of individual catalogues containing up-to-date information on cranes, cupolas, ladles, tumbling mills, core oven equipment, trucks, turntables and trolley systems, air hoists, elevators, side-blow steel converter, and brass foundry equipment, has been issued by the Whiting Corporation, Harvey, Ill. Thumb index cards are inserted between each of the catalogues which are of letter size, 8½ in. by 11 in.

Motor bearings.—"The care of railway motor bearings," publication GEA-60 of the General Electric Company, Schenectady, New York, gives directions for the correct lubrication of sleeve type bearings, considering both armature and axle linings. Brass and babbitt, and iron and babbitt linings are referred to, and instructions are given for rebabbitting bearings. Three photographs showing methods of lubrication, as well as a table showing proper oil levels, are included.

Drop door locks.—A number of application drawings of Wine drop door locks for the guidance of the designing engineer in working out applications to suit various requirements, are contained in an attractive catalogue, No. 41, which has been issued by the Wine Railway Appliance Company, Toledo, Ohio. The catalogue, which contains 40 pages, also features a number of cars equipped with the drop door locks, and vividly shows the method of applying the device and the method of closing the doors on various types of hopper cars.

Absorbo.—A system of isolation of machinery vibration known as Absorbo, is described in a four-page circular issued by the Cork Foundation Company, New York. This material, adaptable to a large variety of machinery, including power plant apparatus, is a natural cork product made in strips 1½ in. thick, which are set in rigid steel frames with lateral braces under individual machines or under entire areas where machines are set closely together. When properly applied, vibration set up by moving machinery is greatly reduced or entirely eliminated.

Stokers.—Detroit underfeed stokers of the single retort type are described in an attractive 32-page bulletin, No. 1018, just issued by the Detroit Stoker Company, Detroit, Mich. Among other items of outstanding interest to combustion engineers, the bulletin contains a number of fuel bed cross sections showing conditions of the fire with respect to air distribution and movement toward the dumps. A section of the book is devoted to the application of the stoker to both low and high set boilers and another section shows how twin settings serve very large boilers.

Automatic controllers.—Automatic controllers for temperature, pressure, humidity, liquid level, condensation and other factors which are important to the success of industrial processes, are described in the new catalogue issued by the C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y. The catalogue resembles preceding editions, but is larger and several more instruments are listed. The importance of automatic control in various industries is stressed in a six-page introduction which is entirely new. An interesting discussion of automatic control problems in a number of industries follows, and many actual cases are cited.

Locomotive feedwater heaters.—The Superheater Company, New York, has just issued a new catalogue describing and illustrating the theory, construction and application of the Elesco non-contact type of locomotive feedwater heater. The catalogue, which contains 24, 8¼-in. by 11-in. pages, is a treatise on steam production and its utilization in locomotives. With the aid of diagrams accompanied by test, the increase in efficiency of the locomotive through the application of a feedwater heater is explained and what this amounts to in actual dollars and cents under varying conditions. The latest designs are illustrated and many typical installations shown.

Shop handbook on tool steel.—Tool steel that is purchased from a mill or a warehouse is not, as a rule, a finished product. It is for this reason that Joseph T. Ryerson & Son, Inc., Chicago, has prepared a book for the tool steel user as he is the one who must change the tool steel from a semi-finished to a finished product. For the successful carrying out of this operation certain definite information is necessary. This book, which contains 80 pages with illustrations and tables, presents to the purchasing agent, superintendent or the tool maker a technical subject treated in a non-technical way. The book contains chapters on the following subjects: Choosing the proper steel for the job; heat treatment of tool steel; heating tool steel; heating equipment; forging tool steel; annealing; quenching; tempering; testing tool steel; heat measurement; grinding. This book should be in the hands of every user of tool steel as it contains valuable information which is generally found only in highly technical books.

Valves and fittings.—A comprehensive catalogue, No. 83, containing more than 700 pages descriptive of a large variety of valves, fittings and tools, wrought pipe and supplies for steam, water, gas, oil and air installations, is being issued by the Walworth Manufacturing Company, Boston, Mass. The new catalogue is bound in cloth and contains many new devices, among which is included a line of hydraulic steel and iron flanged fittings for 800-lb. cold water working pressure, known as the American hydraulic standard. The new Sigma cast steel fittings and valves are shown in a section which includes also the complete line of drop forged steel fittings. Other items of recent development are pipe hangers and brackets, tested air brake elbows and tees, double disc gate valves for use in oil refinery and pipe line service, an 800-lb. American standard steel and iron gate valve, a new design of yoke top iron body globe, angle and cross valves and steel and iron yoke top globe angle and swing check valves for 250-lb. working steam pressure. Information on a new line of needle point globe and angle valves for fuel oil and gasoline is given, and stop and waste globe valves are listed in ½-in. and ¾-in. sizes. Sections are devoted to specialties and engine and boiler trimmings. A large variety of wrenches and other tools is shown, and there are pages listing drainage and soil pipe fittings, ammonia fittings and valves and heating material. Tables of useful data, as well as telegraphic codes, are included. Certain sizes of screw and flanged fittings and flanges, valves, cocks, etc., have been eliminated from the catalogue, but are carried in the list of special made-to-order items.

Personal Mention

General

F. M. Reed has been appointed motive power inspector, office of master mechanic, of the Eastern region of the Pennsylvania, with headquarters at New York.

W. P. Lambert has been appointed special assistant of the Central of New Jersey, with duties to be assigned by the superintendent of motive power and equipment.

G. S. Webb has been appointed motive power inspector, office of general superintendent of motive power, of the Eastern region of the Pennsylvania, with headquarters at Philadelphia, Pa.

H. M. Warden, superintendent of the locomotive department of the Missouri-Kansas-Texas, has been appointed mechanical superintendent, with headquarters at Parsons, Kans., succeeding M. C. M. Hatch, resigned.

Master Mechanics and Road Foremen

W. H. Prindall, master mechanic of the Connecticut river division of the Boston & Maine, has been transferred to the Southern division, with headquarters at Concord, N. H.

Charles W. Extrand, formerly locomotive engineer, St. Paul Division of the Northern Pacific, has been appointed road foreman of engines, with headquarters at Minneapolis, Minn.

D. J. Ayers, master mechanic of the White Mountains-Passumpsic division of the Boston & Maine, has had his jurisdiction extended to include also the Connecticut river division.

F. A. Graham, traveling engineer of the New York division of the Pennsylvania, has been promoted to assistant road foreman of engines of the same division, succeeding W. M. Rue, deceased.

H. A. Bliss, master mechanic of the Southern division of the Boston & Maine, has been transferred in a similar capacity to the Fitchburg-Berkshire division, with headquarters at East Dearfield, Mass.

Shop and Enginehouse

George H. Massy has been promoted to foreman of the Central of New Jersey at the Elizabethport, N. J., enginehouse.

John J. Martin has been promoted to foreman of the Central of New Jersey at the Phillipsburg, Pa., enginehouse, succeeding George H. Massy.

V. N. Potts, general foreman of the International-Great Northern at Mart, Tex., has been transferred as general foreman to Houston, Tex.

S. J. Starke, roundhouse foreman of the International-Great Northern at San Antonio, Tex., has been promoted to general foreman, with headquarters at Mart, Tex., succeeding V. N. Potts.

H. C. Venter, general foreman, locomotive department, of the Southern Pacific at Sacramento, Cal., has been promoted to superintendent of shops, with the same headquarters, succeeding D. S. Watkins, who has retired.

Purchasing and Stores

W. R. Knauer has succeeded A. G. Follette as supervisor of the stores catalog of the Pennsylvania.

G. B. Hopkins has been appointed division storekeeper of the Gulf & Ship Island, with headquarters at Gulfport, Miss.

G. V. Green has been appointed purchasing agent of the Southern Pacific of Mexico, with headquarters at Tucson, Ariz.

R. J. Gable has been appointed division storekeeper of the Illinois Central at Mattoon, Ill., succeeding A. E. Walters.

F. L. Doss, division storekeeper of the Southern Pacific at Dunsmuir, Cal., has been transferred to Bakersfield, Cal., succeeding J. F. Brown.

E. H. Polk, district storekeeper of the Southern Pacific at West Oakland, Cal., has been transferred to Sacramento, Cal., in place of E. Harty.

J. G. Warnecke, division storekeeper of the Illinois Central at Centralia, Ill., has been transferred to Paducah, Ky., succeeding B. T. Adams.

M. E. Baile has been appointed district storekeeper of the Missouri Pacific, with headquarters at Kansas City, Mo., a newly created position.

A. E. Walters, division storekeeper of the Illinois Central at Mattoon, Ill., has been transferred to Centralia, Ill., succeeding J. G. Warnecke.

J. F. Brown, division storekeeper of the Southern Pacific at Bakersfield, Cal., has been transferred to Ogden, Utah, in place of H. W. Concannon.

H. W. Concannon, division storekeeper of the Southern Pacific at Ogden, Utah, has been promoted to district storekeeper at West Oakland, Cal., succeeding E. H. Polk.

A. J. Mello, purchasing agent of the San Diego & Arizona, has been appointed general storekeeper of the Pacific Fruit Express, with headquarters at San Francisco, Cal.

W. F. Naumann has been appointed division storekeeper of the Illinois Central, with headquarters at East St. Louis, Ill., succeeding W. A. Skinner, who has retired on pension.

E. Harty, district storekeeper of the Southern Pacific at Sacramento, Cal., has been promoted to assistant general storekeeper, with headquarters at San Francisco, a newly created position.

C. M. Barron, purchasing agent of the Cuba Railroad, has been appointed general purchasing agent of the Consolidated Railroads of Cuba, with headquarters at Grand Central Terminal, New York.

Joseph V. Miller has been appointed assistant general storekeeper of the Chicago, Milwaukee & St. Paul. He was formerly western sales representative of the Prime Manufacturing Company, Milwaukee, Wis.

F. J. O'Connor, assistant storekeeper of the Chicago, Milwaukee & St. Paul at Milwaukee, Wis., has been promoted to assistant purchasing agent, with headquarters at Chicago, succeeding G. R. Cooke, who has resigned.

B. T. Adams, division storekeeper of the Illinois Central, with headquarters at Paducah, Ky., has been promoted to assistant general storekeeper of the Southern lines, the Yazoo & Mississippi Valley and the Gulf & Ship Island, with headquarters at Memphis, Tenn., succeeding W. D. Stokes, deceased.

F. W. Mahl, director of purchases of the Southern Pacific, whose headquarters were recently changed from New York to San Francisco, has now been appointed general purchasing agent, with headquarters in the latter city. He will have general supervision of the purchasing and stores departments of the company.

Car Department

James W. Gibbons has been appointed general foreman, passenger car department, of the Atchison, Topeka & Santa Fe, with headquarters at Topeka, Kans., succeeding H. J. Neiswinter, retired. Mr. Gibbons was born in St. Louis, Mo., and educated in the grammar schools at Decatur, Ill., his first railroad work being with the Wabash. He has been an employee of the Santa Fe since August, 1887, and for the past two years assistant general foreman. In addition to his duties as general foreman, passenger car department, Mr. Gibbons retains his duties as supervisor of all paint matters of the mechanical department.

Obituary

Allan Bourn, formerly purchasing agent of the Michigan Central, died at Dorset, Vt., on July 13.

W. D. Stokes, assistant general storekeeper of the Illinois Central, with headquarters at Memphis, Tenn., died at Jackson, Miss., on July 20.

R. H. Briggs, formerly master mechanic of the St. Louis-San Francisco at Memphis, Tenn., who retired from active service in 1913, died at Memphis on July 3.

Railway Mechanical Engineer

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Using the Railway Mechanical Engineer

In the September issue we commented upon practical ways in which some of the mechanical department officers are utilizing the *Railway Mechanical Engineer*. Our comments apparently struck a responsive chord, because we have since learned of several officers who are regularly asking at least some of their subordinates to read certain specific articles and advise whether the principles, methods or practices described have been tried, or whether better results can be secured in other ways. One superintendent motive power in particular, asked all of his subordinates, down to and including the foremen, to tell what they thought of the first two prize articles on "The foreman and his responsibility" and the correspondence in the August number relating to "Bill Brown's" first prize article. In the neighborhood of 175 reports were received indicating that his associates had closely read all of these articles and outlining the extent to which they agreed or disagreed with various suggestions which were made. It is difficult to estimate the results of the careful study of these articles on even one railroad by all of those who occupy positions of leadership in the mechanical department. Does anyone question the great importance or value of making use of the *Railway Mechanical Engineer* in this way? Would it be worth while to have some one person on the staff of the mechanical superintendent select those articles of special merit which are of interest to different classes of foremen and officers in the mechanical department and ask for a report on whether the ideas suggested are in use or could be applied to advantage?

Periodical shopping of freight cars

The *Railway Mechanical Engineer* has frequently commented on the lack of systematic methods of bringing in freight cars for general overhauling. Contrary to the practice with respect to locomotives by which a regular cycle of shoppings for classified repairs is established, most generally on a mileage basis, freight cars have been placed in the shop in a haphazard manner with little attention to regularity or the condition requirements for the most economical overall maintenance cost. It is very encouraging, therefore, to find at least one railroad which is giving much the same attention to the advance scheduling of the heavy repairs on its various series of freight cars that locomotives have long received. There are, no doubt, other railroads that are now giving this subject serious attention, but those who read the paper on the subject of the progressive system of freight car repairs presented by F. A. Starr at the convention of the Chief Interchange Car Inspectors' and Car Foremen's Association, which will be found on another page in this issue, will recognize that the Chesapeake & Ohio is doing a notable piece of work in combining the periodical shopping of its cars by series with such production methods in the shops as the segregation of the cars in each series, employment of the progressive system of shop operation, the specialization of shop forces and the scheduling system.

Mr. Starr's paper, since it deals primarily with that subject, places the greatest stress on the progressive system of putting the cars through the shops, and, indeed, it is this system which has made possible the application of the scheduling system, with its reduction of lost motion and waste supervisory effort, to freight car work. To the progressive system must also be credited the development of a regular program of periodical shopping because the fullest advantage of the progressive system could not be taken unless such a program were in force.

Probably the greatest difficulty encountered in any attempt to apply production methods to freight car repairs arises from the difficulty of providing the various shops on any railroad with a regular supply of cars of the same series, all of the same type of construction and the same age and, therefore, all requiring approximately the same type of material and operations in their rehabilitation or reconstruction. It is true that this is a real difficulty if an attempt is made to take the cars out of service without carefully laid plans having been developed well in advance of the beginning of the repair program. It is precisely at this point that the development of a regular program of periodical overhauling of each series of equipment becomes effective. When once established, it provides the basis on which equipment from the various series may be segregated in sufficient numbers to keep the shops regularly supplied. Indeed it may be said that such a program of periodical overhauling must be the foundation of any structure which has for its purpose the most freight car service for the least maintenance cost.

The foreman's qualifications

The article by W. J. Taylor which was submitted in the competition on "The foreman and his responsibility" and which appears elsewhere in this number, goes frankly to some of the roots of the question, approaching it, however, in quite a different way from the three prize articles which have already been published. Those who have followed these articles closely must recognize the fact that the great value of the competition lies not in any one of the articles, or in the first prize article, but in the group of articles as a whole. Moreover, many of the ideas which have been presented in the four articles which have already been published could very well be amplified and enlarged upon. Mr. Taylor, for instance, makes a very pertinent suggestion about stealing the ideas or suggestions made by subordinates or workers. Intimate contact with men in the ranks and many of the foremen and supervisory officers has emphasized the fact that nothing can do more to lower the morale or discourage ambitious

men than a foreman or officer who claims individual credit for good work or suggestions made by men under his charge. Such an attitude effectively discourages that constructive interest on the part of the men which is so necessary and desirable in the interests of the highest degree of efficiency.

Mr. Taylor in his description of an imaginary staff meeting has cleverly and tactfully touched upon one of the difficult situations which confront many of the foremen and subordinate supervisory officers; a situation, by the way, which has been magnified and thrown into the limelight on some roads on which works councils or organized co-operation have been established. It has been a bit embarrassing to many of the foremen who have consistently recommended detail improvements for a number of years, to have these improvements made when the facts were finally brought out in open council by representatives of the workers. If it were not such a serious problem in many shops, also, the fact that machine tools and equipment 30, 40, 50 or 60 years old are being used to repair 1925 equipment, could well be regarded as a joke. Unfortunately it is no laughing matter for those who have the responsibility of securing efficiency and output.

Among the other pertinent suggestions made by Mr. Taylor we cannot overlook the statement that "spoiling of work is generally the result of poor supervision." What would it not mean to the railroads if the full import of this statement could be driven home and profited by? Some of us will never forget that thorough, efficient superintendent of motive power, who has now passed on, who consistently declared that equally good results could be secured from day work, piece work, bonus or other systems, if those in charge understood just how a job should be done and just how much time should be required to do it—and he proved his assertion by conducting a large shop on a day work basis as efficiently and economically as any other railroad shop in the country. There was a minimum of spoiled work and it was because there was a maximum of efficient and intelligent supervision. There are many other things in Mr. Taylor's article that are worthy of comment, but we could not resist the temptation of making some reference to these three things, which in some ways stand out above the others.

Emphasis upon the human element

Sometimes we receive a severe jolt when we set up a measuring stick and see what rapid progress has quietly been made over a comparatively short period along more or less radical lines. There has been much discussion in recent years about personnel departments on railroads. Vice-presidents in charge of personnel have been appointed, or we have noted the quiet inauguration of personnel work under the direction of chief executives, who have added personnel experts to their staffs whose titles might mean anything.

Not a few mechanical department officers rubbed their eyes recently when the New York Railroad Club announced that the address at its September meeting would be made by Edwin F. Daley, assistant to superintendent of motive power and equipment—director of personnel—Delaware, Lackawanna & Western. Mr. Daley had had a thorough experience in the mechanical department work on the railroads, but was taken from one of the industries a year and a half ago to specialize on personnel matters in the mechanical department of the Lackawanna. So quietly and unobtrusively has this work been carried on that only a comparatively few people outside of the Lackawanna knew anything about it, and these were largely men from other roads who were interested in personnel matters.

Many people have assumed that Mr. Daley is the only man who has been specializing on this sort of work entirely within the mechanical department. It is quite probable, however, that if a careful survey were made, similar experts or officers might be found in the mechanical departments on a number of railroads. The name will not be found in the Pocket list of Railway Officials, but among the attendants at the meeting of the New York Railroad Club was David A. Henderson, who for the past two and a half years has been acting as personnel supervisor on the staff of the superintendent motive power of the Long Island. Mr. Henderson came to that road without railway experience, but with considerable training in personnel management in other industries.

Only last June, F. H. Becherer, general car inspector on the Boston & Maine, was made assistant to the mechanical superintendent. No general public announcement was made of the exact duties to be undertaken by Mr. Becherer, but it was understood that he would give all of his time to personnel matters and would be provided with such assistance as might be required. Mr. Becherer, while he was general car inspector, found an opportunity to assist in the promotion of foremen's clubs on the Boston & Maine and has always taken a keen interest in personnel matters, particularly along educational lines.

These developments are surface indications of a great and fairly rapid evolution which has been taking place in the railway field, and particularly in the mechanical departments of our railways. Emphasis today is being placed more and more on the importance of the human element in the organization. This has brought to the very forefront the necessity for the highest type of leadership on the part of the foremen and supervisory officers. It accounts to some extent for the great success of the *Railway Mechanical Engineer* competition on "The foreman and his responsibility." Such a competition announced even five years ago could not have attracted nearly as widespread interest or have inspired so large a number of contributions. It is doubtful, also, if the standard of the prize papers would have been anywhere nearly as high as those received last spring, the fourth of which is published in this number.

Traveling Engineers' Association hitting the ball

A résumé of the proceedings of the thirty-third annual convention of the Traveling Engineers' Association, held at Chicago recently as reported elsewhere in this issue, leads unavoidably to the conclusion that this association has increased the sphere of its influence and activity until now it is a real factor in providing efficient transportation service on steam railroads. In fact, it is "hitting the ball," and, since there is always room for improvement in associations of this kind, it is a pleasure to record that every indication points to an increased activity on the part of members of the Traveling Engineers' Association during the coming year and an even better convention in 1926.

Traveling engineers occupy a strategic position in the railroad transportation machine because of their intimate contact with operation. They are the supervisors most closely in touch with the men who move trains. All the equipment the railroads own can never earn a penny until it moves. It would be difficult to over-estimate the value to each railroad of its able traveling engineers who, by instruction, encouragement and practical example, influence locomotive enginemen and firemen to operate locomotives in either road or switching service more intensively and economically. If the traveling engineers on a single road are important, the influence of the Traveling Engineers' Association, embracing as it does members from practically every railroad in this country as well as

representatives from Canada and Mexico, is proportionately greater. The membership of the association in 1924-25 was 1,486, 252 members being reinstated during the past year and 105 new members added, making a total of 1,843 railroad men at present holding membership in the Traveling Engineers' Association. We do not recall one of the minor mechanical associations which goes into the discussion of reports as thoroughly as do the traveling engineers, and, as long as proper control of the discussion is maintained to keep it pertinent and on the subject, this feature should be encouraged.

The officers of the Traveling Engineers' Association during 1924-25, including the association's veteran secretary, W. O. Thompson, are to be congratulated on the success of the convention just passed. The prospects for an even better convention next year are most promising. The president elect, J. N. Clark, chief fuel supervisor of the Southern Pacific, brings to his office a wide experience in association work of this kind and he has already set a goal of 500 new members for the association in the coming year. There should be no difficulty in reaching this mark if the railroad men who are already members of the association catch a vision of its possibilities, do a little boosting, and go out individually after new members.

Plans for the convention in 1926 are already under way and a simple reading of the following list of subjects on the program without any attempt to analyze each, gives a good indication of what may be expected at the next convention: "The locomotive of today," "Smooth train handling," "Practical instruction for new firemen in combustion and locomotive operation," "The locomotive booster," "Locomotive availability in 100 per cent condition for operation," "How can the traveling engineer cover his growing job?" In addition, it is proposed to schedule the time for each report and its discussion so that members who are unable to attend the entire convention can arrange to be present on the day in which subjects of particular interest to them are to be presented.

All well wishers of the Traveling Engineers' Association will personally interest themselves in the next 12 months in securing new members, invest ungrudgingly a portion of their time in the preparation of committee reports if requested, boost the association to their superiors and make plans as far in advance as necessary for attendance at the convention next year.

New Books

A Manual of Locomotive Running Shed Management. *By Walter Paterson, staff department, London, Midland & Scottish Railway, Manchester, England, and Harry Webster, running department, London & North Eastern Railway, Lowestoft. 212 pages, illustrated. 6 in. by 9 in. Price $6.00. Published by Charles Griffin & Company, Limited, London, and J. B. Lippincott Company, Philadelphia.*

The object of this book is to present, in a convenient form, the essential information relative to the efficient management of steam railway locomotive and car shops as conducted in Great Britain. For the mechanical department officer engaged in railroad work in this country, considerable information in this book is of interest, especially the methods recommended for handling locomotive repairs. The authors have intentionally refrained from giving detailed descriptions of shop processes and operations, but have included descriptions of engine-house equipment and practice. It has been written primarily as an introductory manual for the use of junior officers and foremen in charge of departments.

It contains 13 chapters, with 44 illustrations, discussing such subjects as the organization of the staff and functions of its various members, personnel and employee welfare, stores department organization and management, fuel conservation, computation of locomotive mileage, locomotive and coach cleaning, locomotive and car repairs, causes and remedies for engine failures, methods used in handling wrecks, and the utilization of waste material. A number of tables are also given in an appendix in the back of the book showing the approximate temperature of a fire as indicated by its appearance, the approximate temperature of a car journal as indicated by its appearance, the strength of chains, capacity of water tanks, the delivery of injectors in gallons per hour, etc. Descriptions of a number of jigs and tools suitable for engine-house and wrecking service are given in the chapters devoted to locomotive repairs and break-downs.

Tests for Railway Material and Equipment. *By Henry Knauer, 257 pages, illustrated, 4¾ in. by 7½ in. Price $3.00. Published by the Simmons-Boardman Publishing Co., 30 Church Street, New York.*

The material contained in this volume is elementary in its scope and is intended for those taking up testing work in the laboratory and for those in the shops aspiring to engage in inspection of railway materials in the field. The tests are explained in such a clear, concise manner that a novice in this work should experience no trouble in grasping the fundamentals necessary for a successful laboratory analysis. The phraseology is such that all calculations and arithmetical substitutions are readily comprehended without recourse to chemistry or higher mathematics.

The first two chapters are devoted to the explanation of the nature of a test and with the methods and importance of recording the results of the findings. The next two chapters go into a detailed explanation of water and the treatment of the various mineral and organic compounds which may be found in it to cause trouble, particularly in a locomotive boiler. For a necessarily brief treatment, this particular subject is well handled. It is followed by several chapters dealing with all the tests required to determine the quality of paints and varnishes. Various oils and greases are briefly covered. More information on these materials should have been included but the reader can obtain an idea of the fundamental requirements of a good oil and grease. Chapter X contains a list of nine mechanical materials which the author quickly passed over with a few elementary remarks. The various laboratory tests to determine the quality of rubber goods and cement are explained in a very thorough manner. Chapter XIV contains four pages on the subject of cast iron. Considerable more space could have been devoted to this important subject. The chapters on wrought iron and steel products are well done and the chapters dealing with tension, hardness, fuel heat value tests and flue gas analysis are well worth reading for those handling these tests in the laboratory. The chapters dealing with the quality of steam and steam boiler tests and the methods of determining indicated and brake horsepower contain elementary information for novices interested in these tests. The last four chapters touch briefly on the subjects of the calculation of the test results of a steam engine, power reverse gear, locomotive road tests and tonnage rating tests.

The author omitted from his book any information pertaining to the testing of tender and car wheels, locomotive wheel centers and tires, glass, copper bearing steel, sheet metal, creosote for wood preserving, lumber and the testing of electric light bulbs and wire. These are essential railway materials and to make the book comprehensive should have received the same consideration as those actually covered.

In writing this book the author has inadvertently limited its usefulness by not considering the testing of material from the standpoint of the material inspector in the field. These men are always anxious to obtain any information which will aid them to make a thorough inspection of the materials they are called upon to inspect thereby protecting their interests as well as those of the railroad which they represent.

The elementary nature of the volume makes it suitable for the novice entering the testing laboratory and for the shopman whose desire is to take up the testing and inspection of materials.

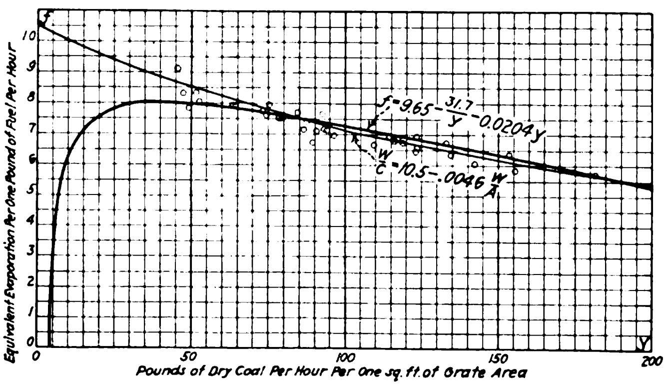
What Our Readers Think

The evaporative capacity of locomotives

ALTOONA, PA.

TO THE EDITOR:

The articles on "Evaporative capacity of locomotives," by Alexander P. Poperev, are certainly worthy of serious study since they vary in principle from generally accepted methods used heretofore. The theory presented involves more calculations than those of Dr. Goss and Lawford H. Fry. All three theories are empirical and necessarily cover arbitrary assumptions based on locomotive tests. These arbitrary assumptions differ materially. The additional burden of calculations will be justified only if the results are more accurate. Therefore, careful comparison of results of calculations, with test data available, should



Curve plotted on Fig. 6 from Dr. Goss's formula for purpose of comparison with the Poperev curve

be made before discarding the simple method of Dr. Goss for the more complicated method.

Dr. Goss's method which I have used for more than 25 years, was found adequate for the purpose and agrees closely with test results. It is true, as stated by Mr. Poperev, that there are heat losses from various causes, that coal can be burned on the grate without using any steam or increasing boiler pressure; but such losses are in the nature of "standby losses" which are, invariably considered separately. It is possible to estimate from the B.t.u.'s in a pound of steam and in a pound of coal, the theoretical maximum rate of evaporation per pound of dry coal. Allowances for heat losses and for coal losses, due to grade of coal and method of firing, can be deducted. The coal losses vary as much as 30 per cent at very low rates of combustion, between hand-firing and stoker-firing, but at high rates of combustion are nearly equal. They also vary for different kinds of stokers. But these losses, apparently, do not affect the nature of the curve which represents equivalent evaporation per pound of coal within the range in which a locomotive is worked on the road. All of the many tests made indicate that this curve, when based on increasing water rates, is a straight line. It is certainly proper to make assumptions for these losses, subtract them from the theoretical rate and establish the ratio of equivalent evaporation to a pound of dry coal for different rates of evaporation or coal consumption; but such arbitrary assumptions must be checked by tests, the results of which usually show that discrepancies from the estimated results are due to the grade of coal, or method of firing, or both.

Mr. Poperev failed to show a comparison of the methods which he criticized with his own, but condemned the other methods for technical reasons, which seem to be questionable, since they obtain only outside the range of action of a locomotive doing useful work. For a study of the value of his theory, some of the figures in his article can be analyzed to check his summary statement in the September, 1925, issue of the *Railway Mechanical Engineer,* page 554, reading: "On the contrary, by applying the same analysis to expressions, 17 and 21, we fail to find any similar contradictions, which fact can be considered an additional proof that the basic expression, (6) from which these formulas are derived, is correct."

Above this statement appears Fig. 6, giving results taken from Dr. Goss's tests with Mr. Poperev's formula for these tests and a line representing that formula. Not having a copy of those tests at hand, I have taken some of the points representing individual tests, from which Dr. Goss's formula would be:

$$W/C = 10.5 - .0046W/A$$

in which A is the area of the grate in square feet.

This formula, which is based on the rate of steam generated, translated to a basis of coal used, gives the results:

Dry coal lb. per sq. ft. of grate per hr.	25	50	75	100	125	150	175	200
W/C	9.44	8.54	7.80	7.20	6.67	6.22	5.82	5.47

Referring to the chart, it will readily be noticed that if these values are transcribed on Fig. 6, the resulting curve fits the tests much better than the Poperev curve.

Using the same method on Fig. 5, page 554, for efficiency, Dr. Goss's method would indicate the formula

$$E = .855/(1 + .0072C)$$

The curve plotted from this formula again fits the tests much better.

In Fig. 1, page 488, of the August, 1925, *Railway Mechanical Engineer,* the formula for the top chart (B. & W.) boiler would be:

$$W/C = .236 - .0067W$$

for the center chart (Whitman's tests)

$$W/C = .257 - .0046W$$

and the bottom chart (F. R. R. test)

$$W/C = .16 - .0057W$$

It should be understood that since the formulas given above are based on the meager test data gleaned from the figures given with Mr. Poperev's articles, they are not necessarily accurate, but they do permit a comparison between the methods of Dr. Goss and Mr. Poperev.

Those interested in this subject may take the trouble to trace out the curves by these formulas. They will find that, by Dr. Goss's method, more accurate agreements with actual tests are obtained than by Mr. Poperev's more elaborate method. Hence, instead of having proved that the basic expression (6), from which his formulas are derived, is correct, he has presented evidence which enhances the value of Dr. Goss's method.

The Lawford H. Fry method has not been discussed in this letter, because his investigations were intended more for analysis of heat transfer and his assumptions for ratio of W/C are only incidental to that subject.

W. F. KIESEL, JR.,
Mechanical engineer, Pennsylvania Railroad.

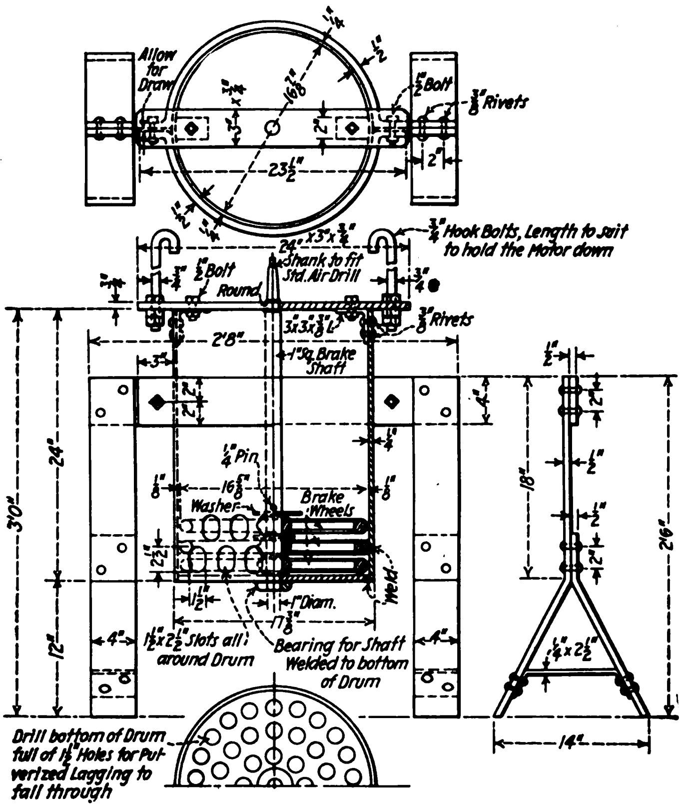
Reclaiming asbestos locomotive lagging

Milwaukee, Wis.

To the editor:

I was interested in the letter from Theo. Nygren on the reclaiming of asbestos locomotive lagging published on page 541 of the September, 1925, *Railway Mechanical Engineer*.

It is an ordinary occurrence on many roads to find an accumulation or surplus of second-hand and small pieces of boiler lagging. There is no market suitable to dispose



Grinder for powdering used asbestos lagging

of this material is scrap and it often-times happens that the surplus finds its way to the dump. This lagging represents a value practically as good as new material and it is not absolutely necessary that new lagging be used in all cases. The second-hand lagging can be powdered and reduced to a plastic state and together with short pieces can be used for filling in around locomotive cylinders, steam chest steam pipes, domes, back boiler heads and for stationary boilers, steam pipes, feedwater heaters, etc.

If the second-hand material is first used for these purposes, there will be little or none left for compressing into blocks and new blocks for locomotive boilers only need be purchased.

An inexpensive power operated tumbler or grinder for powdering second-hand lagging can be constructed in almost any railroad shop. The drawing illustrates such a device. An air drill is used to furnish the power. The pulverizing consists of three hand-brake wheels at the bottom of the container. The top and bottom wheels revolve with the square shaft and the center wheel is bored out sufficiently for the shaft to turn inside of the hub. This wheel is held stationary by welding the rim to the wheel of the container.

C. H. Bilty,

Mechanical engineer, Chicago, Milwaukee & St. Paul.

Burning the woodwork on steel underframes

Brownwood, Tex.

To the editor:

I have just received the September issue of the *Railway Mechanical Engineer* and shall try to answer the question asked by F. W. Bason as to how fire affects the steel underframes of box cars that have had the woodwork burned off. The effect on the steel underframes will be one of two things. If water is applied to hasten the cooling of the metal, you will crystalize the steel. Some parts may be heated more than others, and to replace them in service may cause failure. On the other hand, if the metal is allowed to cool slowly, it will be inclined to anneal or soften. There will likely be a weakening owing to the slight temper in the steel. The frame will sag more easily, but will not break owing to crystallization.

A Reader.

Treating hot driving boxes on modern power

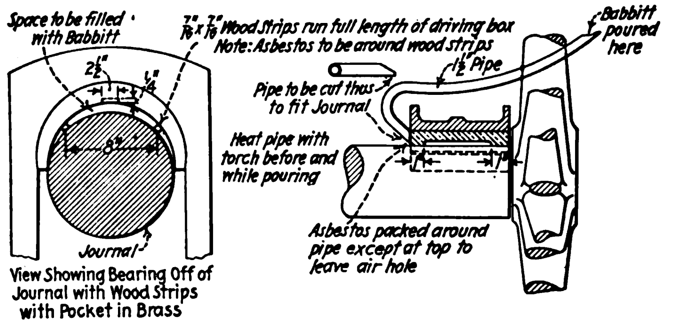
Peru, Indiana.

To the editor:

The problem of treating a hot driving box or journal is one that has caused the mechanical department worry and especially when the transportation department is calling for more power. Having had considerable experience in shop work and also some years of experience as an engineman, I believe that I can write on the subject.

Dropping wheels for a hot box is a big job, even if it is done in a modern enginehouse and if the facilities are not modern, it is much worse. Whenever we have a box that has been reported several times as running hot, and after packing the box and giving it close attention and still we do not get the desired results, we jack the box off the journal four or five inches and with an air hammer, cut a pocket in the crown brass 2½ in. wide and ¼ in. deep, being careful not to cut out the ends of the brass.

We then take two pieces of thin wood, thick enough so that the metal, when poured will be ⅜ in. or 7/16



Section view of the top of the box, showing how the babbitt is poured

in. thick. The box is then lowered on the journal and rests on the two pieces of wood, so that the bearing will stand about eight inches from the floor, after which it is packed with asbestos, a gate made and the babbit poured into the box. It is not necessary to remove the pieces of wood. Old piston packing having copper in it, that has been removed from superheated locomotives, gives a good bearing. This will apply to all driving boxes except the main box.

This method is something out of the ordinary and the work can be done in about six hours and the locomotive is ready to go into service.

J. E. Allen.

"Bill Brown" and "Top Sergeant"

One of "Bill Brown's" old shopmates backs him up— Day of bullying foreman is past

BECAUSE of the large number of mechanical association conventions which are reported in this issue, it is necessary to place severe restrictions upon the amount of space that we would like to devote to the "Bill Brown"—"Top Sergeant" controversy.

That "Bill Brown" in his first prize article in the June number painted an exceedingly clear picture of his early experiences, is indicated by the fact that two of his early shopmates recognized the picture and got in touch with "Bill," although he disguised his identity by writing under an assumed name. One of these men had neither seen nor heard of "Bill" for many years and wrote to us asking for information as to his whereabouts. The other one has been keeping in more or less close touch with "Bill" and has come to his aid under the signature of "Old Railroader," with a splendid contribution, which we take pleasure in passing on to our readers.

Mr. Maguire, whose letter we also print, suggests that "Top Sergeant" is a fake and that his contribution was probably prepared by one of our editors to, in effect, set up a "straw man" to knock down. It may be to the discredit of our editors that they were not ingenious enough to think of resorting to such a subterfuge, but we beg to assure Mr. Maguire and others who may have similar illusions, that "Top Sergeant's" letter was not written by a member of our staff and that its receipt not only came as a distinct surprise, but caused no little excitement in the editorial sanctum. As an effective answer to Mr. Maguire and others, we simply want to drive this question home. In thinking over your experiences and acquaintances, how many foremen and supervisors have you known or do you know who reflect in a greater or less degree the "Top Sergeant" attitude?

The letters from "Old Railroader" and Mr. Maguire follow:

A friend of "Bill Brown"

By "Old Railroader"

The first prize article on "The Foreman and His Responsibility" in your June issue by "Bill Brown" I read with unusual interest because its opening sentences about his having been a clarinet player in a certain band a number of years ago, and his graphic account of his foreman's interview with him, revealed to me that "Bill Brown" is none other than an old shopmate of mine, who is now one of my most intimate and esteemed friends.

That foreman of his, who was also my foreman, has long since gone the way of all the earth, and there is a Latin proverb, "Let nothing but good be said about the dead," but surely facts may be stated.

Well, I have read in your August number "Top Sergeant's" drastic criticism of "Bill Brown's" article, and from it I conclude that he is almost the exact counterpart of "Bill Brown's" foreman. This latter gentleman had a very exalted idea of his position. The king upon his throne, or the President in the White House was a small potato compared to a railroad shop foreman. He was "Sir Oracle and when he ope'd his mouth, let no dog bark." Yet he possessed no theoretical knowledge of mechanics. He was unable to make the simplest mechanical calculation. He scorned to read such publications as the *Railway Mechanical Engineer*. He perhaps had never heard of such a thing as a vernier, but he possessed one accomplishment. He was a rapid and beautiful writer, and the facility with which he could whip out his order book, and write an order for a man's discharge was only equaled by the facility with which Mr. "Top Sergeant" can show the gate to the man or men who do not please him. "Bill Brown's" foreman handled the apprentices in a way that would rejoice the heart of Mr. "Top Sergeant" and many a bright boy of sensitive nature he drove out of the shop by his harshness and cruelty.

How did he himself make out by his bull-dozing, ignorant brutality? Did he rise step by step till he reached the highest position in his line? No! He was put back to run a machine, and a sorry job he made of it. He jumped about like a bear on a hot gridiron and accomplished very little, while an elderly Scotchman near him accomplished a great deal. Yet the Scotchman was apparently slow and deliberate in his movements, but every move was in the right direction. Finally Mr. Ex-Foreman was discharged. He got a job overseeing the mixing of cement for the corporation. Then he went to work in a railroad shop in a neighboring city, and soon he died. Of course, we hope Mr. "Top Sergeant's" career will not end so ignominiously.

Mr. Editor, you spoke of Mr. "Top Sergeant" as "an old-fashioned, hard-boiled type of foreman." It is to be hoped he is the sole surviving member of the hard-boiled type of foreman.

"Bill Brown's" article breathes the gentler, more enlightened, more humane spirit of the present day. It recognizes the fact, for it is a fact, that better service can be obtained from men, by friendly, tactful handling, than by treating them as though they were mere "dumb driven cattle." His article reflects throughout his own splendid, large-hearted, common-sense personality.

In his suggestion of the new foreman calling his men together, and talking to them in the manner he outlines, he is in very good company. A newly-appointed president of a vast railway system, went from point to point on the system where large numbers of men were employed. He called them together in all their grime and addressing them in a friendly way, told them that the success of the system depended on the faithful and hearty co-operation of every employee with the management.

His suggestion as to the treatment of the new employee, which is humane and considerate, must meet with the approval of every right thinking person. No foreman can size up a new man in 20 minutes. Some men, and good men, too, experience on beginning work in a strange shop, something akin to "stage fright." They imagine they are the objects of critical attention. They are self-conscious and for a time are not their true selves at all. "Bill Brown" takes note of this and would help them through the period of strangeness.

His remarks on new tools or machinery, on the sales engineer, on the conservation of material, are all good and sensible, but the writer particularly likes what he says about the attitude of the foreman towards the apprentices. Despite the sneers of Mr. "Top Sergeant" it is

in line with what is being done by great railway systems —the Santa Fe, for instance—to train and educate their apprentices. It is being more and more recognized that hands are more skilful and efficient when directed by well-trained brains.

Mr. Editor, it was a pleasure to me to read this article from the pen of my old friend, "Bill Brown." It meets with my approval, for it expresses my own sentiments better than I could possibly have expressed them, and the fact that you saw fit to award it the first prize, shows that it meets with your approval also.

Foreman must prove worth as a leader

By George T. Maguire

Boiler inspector and gang leader, Delaware & Hudson, Whitehall, N. Y.

If publicity leads to fame, "Bill Brown" is due for a place in industry's "Hall of Fame." He sure did "start something."

In presenting my personal views on the subject of his article, I cannot help including my views on the article of criticism offered by the "hard boiled" foreman who, to make himself sound "hard boiled," appropriated the nom de plume, "Top Sergeant." At the start let me state that I firmly believe that the article was written by the "top kick" (whom I'll wager is employed, not as a foreman but as an editorial writer) to purposely prolong the discussion of Brown's article. That it will fulfill its purpose, I have no vestige of doubt. If this writer really tried to increase his hardness by calling himself "Top Sergeant" let it be understood that the title is a misnomer. The war tamed the hard boiled "tops," as modern practice in industry has tamed the bully foreman.

Regarding a foreman's expectation of receiving thanks from a workman. Why should a workman thank the foreman? What foreman worthy of trust would approve a raise in the pay of a workman if that man was not deserving? And if a man is deserving of the increase, will it not reflect creditably upon the foreman? Does it not show that he has made another man more efficient? Therefore the increase is a 50-50 proposition. It means that the company is showing its approval of the foreman's system of increasing production, for increased production is increased efficiency and the foreman is showing his appreciation to the workman for making the increase possible. Need the man be thankful in words to the foreman? Will not a continued effort mean more than any number of words of thanks? In this case the "Top Sergeant" would be holding grievances and this according to his own words would eventually result in the "canning" of the workman. Would he be a competent foreman in dispensing with the services of a man who has proven worthy of a raise, simply because he forgot to say "thanks." How much would he save for the company?

I wonder just what the "hard boiled" foreman means by "he man." Does he mean a man of massive proportions whose remarkable strength is apparent but whose lack of reasoning power is appalling? Roosevelt was called the "Red blooded he man President"; did he think only of himself and his personal viewpoint?

Then comes the "top's" views on railway journals. What a fraud this man turns out to be. What man ever advanced from apprentice to journeyman unaided? Perhaps our "top" was born with all his knowledge. If we can advance unaided why not start as superintendents of motive power or master mechanics at least? Why be a mere foreman. Let us suppose our hardboiled foreman to be about fifty; he perhaps has thirty-five years' service on the road, say twenty years as a foreman. He was a foreman in 1905 when the Walschaert valve gear was brought to this country, when superheated steam was born, when the No. 6 E. T. air brake was put on the market. Who taught him what he knows about them? What does he know of welding methods, of three cylinder engines, unless he has read of them in journals or has had them explained to him by those who have read these journals, or who have been sent to help him by the builders? He is a blood brother of the boilermaker who continues to bead flues by hand because the pneumatic hammer gives him a cold in the head.

Concerning relationship to other departments. All departments combined make the road; if one falls behind the road suffers. Should we co-operate? The "ayes" have it.

Now for "Bill Brown." Bill's plans of telling the men what he expected of them is O. K. but, as he says, later, all men cannot be talked to alike. I believe that Bill should have interviewed his men separately instead of calling them together in this way; he would be able to get each man's views on his promotion and establish a personal relation with his men.

It is not always a good policy to explain changes in management, shut-downs, cuts or short hours to foremen but certainly a foreman should keep in touch with business and working conditions and should be interested in new methods of getting work out and to gain this end it is necessary that he read modern mechanical journals.

A foreman should be kindly in his contact with men, not only with new employees but with all employees. He should, however, be strictly impartial. Instead of personally making the new man "at home," I think he should permit him to work with an old employee for a day or two, exercising care in the selection of the employee so that the proper shop spirit may be instilled in the recruit.

Improved machinery or new inventions should be studied so that they may be understood when eventually installed, but undue haste in advocating a change when the old machine is not obsolete and can do the work reasonably fast would be a breach of trust, because it would involve the unnecessary expenditure of a sum which might be used to a greater advantage somewhere else.

Knowing and bringing home to the workman a realization of the cost of material is a subject in favor of which too much cannot be said. It is an absolute misfortune that competitive methods prohibit the manufacturing companies publishing prices of machines and materials in the advertisements in various trade journals. If a railroad company published a list showing the price paid manufacturers for materials the cost of printing it would be saved in 3/8 in. nuts alone.

All material having any salvage value should be saved carefully; only sufficient material to cover the job should be drawn from the storekeeper. Material should be used and conserved as carefully as a good mechanic uses and cares for his tools.

The day of the bullying foreman and the foreman who takes an improper advantage of his position has passed. This is the day of the foreman who has proven his worth as a leader.

President W. J. Harahan, of the Chesapeake & Ohio, has authorized the purchase, at a cost of about $8,000,000, of the following equipment: 20 simple Mallet type locomotives; 75 Mikado, heavy type locomotives; 5 heavy Pacific type locomotives; 10 heavy type switch engines; 125 steel caboose cars; 10 all-steel combination passenger and baggage cars; 3 all-steel mail cars; 2 ditchers; 4 dump cars and 2 locomotive cranes. The company is now in the market for this equipment.

The foreman and his responsibility*

The "big boss" drops in on an imaginary staff meeting—Pertinent suggestions on discipline and conservation

By W. J. Taylor

General foreman, Southern Pacific Company Shops, Sparks, Nev.

WEBSTER'S definition of opportunity is: "Suitable time, combined with other favorable circumstances." One favorable circumstance must be that we shall be fitted by training, study and experience to accept the responsibility imposed upon a foreman.

The opportunities of a foreman in railroad work are unlimited. A glance at those who have succeeded and are holding high executive offices, demonstrates that those who have worked hardest, have been honest with themselves and employers and are morally and courageously firm and just are the ones who have succeeded. They have been able to concentrate their minds on each individual position as they have advanced, and their training and experience has enabled them to meet any emergency unruffled and with quick and able decision, given in a manner to command respect.

Opportunities sometimes seem slow in presenting themselves and many who are over ambitious become discouraged and lose heart at the very moment when promotion may have been within their grasp.

The foreman who cannot apply himself to his job with his whole heart, giving the best that is in him—even under adverse circumstances or criticism—will not succeed. The little demon jealousy must always be watched closely, as he can undermine and destroy the chances of an otherwise successful foreman.

It is a fact that many men have succeeded in securing advancement and recognition through their ability or gift of a good "flow of talk," but those men are generally lamentably weak in doing the real things that count. They usually maintain their precarious standing by informing their superiors that a suggestion or improvement made by Bill Jones was their own particular idea. We must, however, be thankful in knowing that there is now less chance of advancement for this class of man.

We must be experts in our particular line. Opportunity seldom presents itself to those who continually are compelled to say: "I do not know."

As for the so-called strategic position occupied by the foreman and his opportunity for strengthening the organization which he directs, or assists in directing, and making it function more efficiently, we should like to make the following observations:

An interesting staff meeting

Consider a railway terminal shop and roundhouse, with a total of fifty foremen in the motive power department and twenty in the car department. We will inaugurate a practice of holding semi-monthly meetings. The general foreman of each department takes charge of these meetings, which will be held separately for each department because of the widely varied topics which will come up for consideration. Such meetings to be held during regular working hours and to be attended by the heads of each department, and those assistants who can be spared. After the meeting has been opened, and the general foreman has spoken on such subjects as safety, production, co-operation, etc., suggestions are solicited. The results are really surprising.

Those comprising a supervisory staff in the majority of our railway organizations come from all sections of this country and from European countries. These discussions are therefore most instructive. Minutes of these meetings are taken and printed, and distributed to all foremen. Suggestions of merit are referred to the master mechanic, and perhaps higher.

The seventy foremen are especially skilled and intelligent; they were picked for supervisory duties because of this. They are directly responsible in disbursing perhaps $125,000.00 a month. (Some responsible task!) Might we suggest that the general manager of the railroad operating these shops scratched his head one day and said to his superintendent of motive power: "That is a lot of money to intrust to those men to spend each month.

"Let us go over and see if they are really capable." On arriving at the shops they are informed by the master mechanic that a foremen's meeting was being held and they accepted an invitation to attend.

After a few introductory remarks by the master mechanic, both the general manager and the superintendent of motive power make a few remarks and the meeting resumes open discussion. At the invitation of the general foreman the superintendent of motive power takes the chair. Bill Jones, machine shop foreman, gets up and wishes to respectfully draw the superintendent of motive power's attention to the fact that he is using an old wheel lathe, built in 1878, for turning tires on an engine that was purchased in 1924. Bill says he is wondering why the management did not think it necessary to keep up-to-date with its machinery as well as with its locomotives. Superintendent of motive power coughs, and says he will look into the matter.

Next, our roundhouse foreman gets up and states that he is using an old shop-made crane for loading coal into tenders that was made in 1900, and tells of another method with which he had loaded coal while working for the XYZ road. Many other matters are discussed and at the conclusion of the meeting the superintendent of motive power promises the foremen assembled that in the future he will keep his eye a little more closely focussed on them as he realizes they are back of him in producing at a minimum cost.

The foreman's responsibilities

The responsibilities of a well trained, honest, conscientious foreman are such that he should realize and appreciate at all times the trust that has been placed in him. He should have such intellectual and moral capacity as to be able to discriminate and choose between right and wrong. He is accountable to his employer in seeing that money expended under his supervision is wisely spent, that every man employed under him gives an honest day's

* One of the articles submitted in the *Railway Mechanical Engineer* competition on this subject. The first, second and third prize articles have appeared in the June, August and September issues, respectively. Interesting comments on the first prize article also appeared in the two latter issues—the famous "Bill Brown"—"Top Sergeant" controversy.

labor, that material is not wasted, that tools are carefully used and conserved; also that the morale of the organization, over which he supervises is kept up to the highest standard. Also that there is harmony and co-operation between supervisors, between supervisors and men, and between the men themselves. The attainment of proper co-operation between all units of an organization should be a responsibility that all foremen should accept and strive to achieve. Co-operation extending from the head of an organization, and embracing all members of the official family, with the foreman would no doubt tend to make the whole machine function more efficiently.

The pompous official does not sense his responsibility. The foreman and the highest official are (or should be) striving for the same results. In demanding an honest day's work a foreman must know his men, must know how the work should be performed and how much time should be consumed on each job. It is possible for a man to work hard for eight hours and accomplish nothing. Accuracy must be constantly encouraged to prevent the necessity of doing work over. Spoiling of work is generally the result of poor supervision, and added to the waste of money for time expended, the cost of material is usually doubled.

Efficiency cannot be maintained without discipline, but discipline in overdoses is like an overdose of food or medicine,—it makes one more sick. When censuring a man a foreman must be firm. Infractions of established rules must never be overlooked for one man and strict discipline be given another. Encourage your men,—a discouraged man is of little use.

Conservation of material

The conservation of material is a subject that deserves the closest study and the foreman who conserves "until it hurts" is one who surely senses his responsibility to his employer and recognition is sure to come his way. His responsibility should not direct that he should demand of the storekeeper that an enormous stock of material be kept on the shelves, but that no more material be kept on hand than is absolutely essential to the proper running of the plant without delays. By close observation he can anticipate his requirements far enough in advance to eliminate the necessity of large stocks being maintained. Patching and substituting are two practices which should be approached with caution.

The abuse and loss of tools of various kinds should demand the strictest attention. Tools issued and held in tool rooms, or given out to individuals, should be periodically checked and requisitions for materials should be carefully scrutinized by the responsible foreman, who should ask himself in each instance: "Is it absolutely necessary that this material or tool be issued?"

Here is an instance to illustrate how one foreman recognized his responsibility in conserving material: In a plant "once upon a time" it was the custom of the machinists to use white lead on boiler studs, etc., before screwing them into place. The pipe fitters used this same material on pipe fittings. The boilermakers and mechanics got the habit and it was no unusual sight to see little pots, possibly a pipe cap or pieces of paper with white lead on them scattered promiscously around the shop. Suddenly there was an order that no more white lead should be issued for this purpose. Result—saving of many dollars and the work went on just the same.

The average foreman has an intellect that is fertile, capable of development. With encouragement coupled with harmonious co-operation and recognition from his superiors, the foreman is generally eager to grasp the opportunity if it presents itself, and through this sense of responsibility will seldom fail to make good in any task imposed upon him.

Traveling Engineers hold successful convention

Report on mechanical stokers and paper on train control feature annual meeting at Chicago

THE Traveling Engineers' Association held its thirty-third annual convention at the Hotel Sherman, Chicago, September 15 to 18, inclusive. There were about 1,000 members and guests in attendance at the opening session. The report of the secretary showed that the association had 105 new members and 252 members reinstated during the past year, making a total membership at the present time of 1,593.

The opening address was made by W. J. Fee, road foreman of engines, Canadian National, Lindsay, Ont., and president of the association, whose remarks are abstracted below. The association was also addressed by C. G. Bowker, general manager of the Grand Trunk Western, Detroit, Mich., who called attention to the splendid opportunity which members of the Traveling Engineers' Association have of improving locomotive service on the railroads through papers presented at the annual conventions and subsequent discussion. Mr. Bowker said that while the traveling engineer's duties are many, they all are important. He must keep a close supervision upon the power assigned to his territory, riding the engines frequently and keeping in touch with their condition. He must instruct engineers in the proper method of handling engines and see to it that they keep water at the proper level in the boilers, especially on superheated locomotives. He must see that his engines are properly lubricated in order to prolong the life of the cylinder packing and obtain the greatest possible efficiency in operation. Mr. Bowker also emphasized particularly the opportunity of the traveling engineer to improve locomotive performance through the prevention of carelessness and inattention to duty responsible for engine failures and also to a large extent for excessive fuel consumption.

The opening address made by President W. J. Fee, road foreman of engines, Canadian National Railways, Lindsay, Ont., was in part as follows:

Address by President W. J. Fee

Efficiency in railroad work is a matter of education and experience, and is mostly obtained through association with each other and exchanging the views of each

other's experience. Give us the benefit of your experience, and we will keep our members in position to aid in bettering locomotive service on their various railroads. Our superiors will then be satisfied that it is to the interest of every railroad to send its traveling engineers to these conventions to keep them informed as to the latest developments in connection with locomotive equipment and operation.

No association can boast of a wider zone of usefulness, or a better record of achievement than this one. Transportation is the oldest and the newest problem confronting civilization. Transportation has been essential to human well-being and happiness, and has perhaps more accurately reflected human progress and achievement than any other industry, not excepting agriculture.

The locomotive being the prime factor in railway operation, the history of its development is a romance which has no parallel in the records of human achievement, nor can too much credit be given the men whose stupendous labors brought into practical form such devices as the air brake equipment, feed water heater, superheater, stoker, booster, power reverse gear, different valve gears and many of the numerous devices now applied to the present day modern locomotive.

W. J. Fee (Canadian National)
President

J. N. Clark (S. P.)
1st vice-president

J. B. Hurley (Wabash)
2nd vice-president

Progress made in mechanical stokers

Up to June 1, 1924, 8,989 mechanical stokers had been applied to locomotives.

From information obtainable and from personal observation it should be possible for a mechanical stoker of the present-day type to operate approximately 90,000 miles on the locomotive before receiving a general overhauling; however, at the time the locomotive is receiving classified repairs the stoker should receive a thorough inspection and the necessary light repairs be made. It is presumed with reference to the above that the stoker and parts received proper lubrication and correct operation.

Maintenance costs 0.1 to 0.15 cents per locomotive mile

From information available, at sources where inquiries were made, as to actual differential covering cost and maintenance of past types of stokers over that of the present-day type, no figures were to be had; however, the standard type of stoker in operation today can be maintained for approximately 0.1 to 0.15 cents per locomotive mile.

This includes the cost of all stoker parts used at overhauling; however, minus cost of labor.

Due consideration should be given to the construction of locomotive tenders to provide fuel supply for the use of the fireman who either through lack of knowledge in the operation of the stoker or because of a clog occurring may be required to revert to hand firing. As a rule in case of stoker trouble a fireman will make added efforts to hand fire the locomotive if fuel is available without restriction. This will also increase the tendency of firemen to give proper consideration to the use of the scoop during standby and other delays, at which time the temperature of the fire-bed may become low, and if without forethought extreme care is not taken banks may form over the fire-bed through the use of the stoker.

On territory where the application of mechanical stokers is being considered it is important to establish the practice of removing all foreign and non-combustible material at fuel stations and coal mines. Delays will be eliminated by establishing this practice and continuity of operation assured to stokers, thus preventing interruption of service at critical periods of operation during sustained efforts on the part of the locomotive.

The inclination of individuals to study and qualify for promotion has through the application of the stoker shown itself on the increase. The present progressive examination is of such a nature that earnest study must be applied for an individual to qualify from the position of fireman to that of a locomotive engineer.

Influence of stoker on detection of packing blows

Valve and cylinder packing blows should be observed with extreme care. Engine crews should be instructed in the art of testing for them. As the mechanical stoker can and will deliver the required fuel before the weakening of the locomotive due to loss of power is discernible, certain engine crews are not entirely familiar with the proper method of discerning and testing for valve and cylinder packing blows, especially so in the case of superheated locomotives.

Special attention should be given to replacement of stoker parts, as well as maintaining the openings in the firing nozzles, distributing arrangement and true alignment of such parts by the roundhouse forces.

Operation of stokers on inbound or terminal tracks, prior to the arrival or after leaving of crews, except by inspectors, should not be permissible. It is important that fire-beds be built up at terminal points and delivered to the crews in a light and level condition and free from clinkers. Prior to leaving the outbound track the whole stoker should receive close observation of the engine crew, in order to know that it is in serviceable condition and that

the flow of fuel is available. Fire-beds should be built up by hand-firing and a proper degree of heat obtained. The thickness of the fire-bed is to be in proportion to the degree the locomotive will be worked and according to characteristics of the fuel used. Engineers should gradually work their locomotives up to the maximum working capacity needed, rather than in a sudden manner, allowing the firemen to bring the fire up to the proper degree of heat, depth and division of fuel over the grate area as a whole, so that forcing of the fire may not be required. This will insure getting the fire-bed at what we term a light, bright and level condition, which is necessary for securing the most economical results in consuming the volatile gases of the fuel with resultant barometer of efficiency—a clean stack.

Modern stokers promote reliable operation

The schedule of the time table makers and tentatively expected performance of the extra as well as the regular trains by the dispatcher is based upon the even, steady and continuously normal performance of the locomotive. By no other presumption can the plans of the dispatcher become definite. Dispatchers must have certain confidence in locomotives as well as in engine crews to perform certain tasks. These tasks, regardless of weather conditions, the modern locomotives will do, even though called upon to develop in comparatively short time rates of horsepower from zero to a total maximum effort. With the mechanical stoker, dispatchers feel assured that they have a locomotive with which there is no doubt of failure resulting from the physical effort on the part of the fireman in being unable to maintain constant pressure under sustained effort.

The report was signed by D. I. Bergin, chairman, road foreman of engines, Wabash; J. P. Britton, road foreman of engines, B. & O.; J. H. De Salis, master mechanic, N. Y. C.; M. A. Daly, fuel supervisor, N. P.; and Henry H. Wilson, general road foreman, B. & O.

Discussion

In discussing the committee report on mechanical stokers, various members emphasized the points brought out in the report that the modern stoker of improved design is practically foolproof in operation, low in maintenance cost with reasonable care and attention to lubrication, and decreases railroad operating costs. Practically without exception, comments on the report were favorable. Decreased operating cost is accomplished because the stoker makes possible an increased tonnage rating of locomotives, prevents many train delays due to man-failures in firing and under certain conditions saves fuel over the older method of hand firing. In addition, the advantage of the mechanical stoker as a safety device was emphasized in that it enables the fireman to keep a closer watch for roadway signals which may be missed, particularly if he has just put in a fire and is partially blinded by the intense glare from the firebox. In commenting on maintenance, one of the members said that the stoker engines on a series of locomotives built in 1913 have never yet been taken from under the locomotives, all repairs having been made at outlying points with the stoker engines still in place.

J. D. Heyburn (St. L.-S. F.)
3rd vice-president

James Fahey (Nickel Plate)
4th vice-president

R. Hammond (N.Y.N.H. & H.)
5th vice-president

W. O. Thompson (N. Y. C.)
Secretary

Continuous train control with cab signals

By E. Von Bergen
General air brake and lubricating engineer, Illinois Central, Chicago

At this time last year there were but four installations of train control that could be termed service installations, the remainder being test installations. Of the four, three were of the intermittent contact type, viz., the Miller on the C. & E. I., the Regan on the C. R. I. & P., and the American on the C. & O., and one of the continuous induction type, viz., the Union on the Pennsylvania. Since that time practically all of the remaining 45 roads embraced in the first order issued by the Interstate Commerce Commission have contracted with manufacturers for their respective installations, quite a number having a division in operation.

Contact type rendered obsolete

As none of these roads have selected a contact type of device, but have all chosen induction types, either of the intermittent or continuous type, it is apparent that railroad operating officers who have studied the problem are practically unanimously of the opinion that the development of the induction types has rendered the contact types obsolete. The objections which have for years been set forth against contact types, viz., clearance problems, shock resulting when locomotive apparatus comes in contact with wayside, interference of ramps with snow plows, etc., were overcome with the development of the induction types, and once it was proved conclusively that the wayside indication could be transferred aboard the locomotive positively and reliably without any contact between locomotive and wayside apparatus, and this at approximately

the same cost, the death knell of the contact types was sounded.

Intermittent vs. continuous

Although an intermittent type of device meets the requirements of the I. C. C. and generally speaking the first cost of any division installation of the continuous type is substantially greater than that of the intermittent, there is little benefit to be derived from an intermittent device unless speed control is incorporated, and the disadvantages of speed control will be discussed later.

With an intermittent automatic stop, all that can be expected is that the device will apply the brakes and stop the train in the event the engineman fails to stop for a stop signal, or to take proper action recognizing same. From a practical viewpoint, it is apparent that if two or three hundred thousand dollars must be expended for an automatic stop, it is good business to spend 30 per cent or even 50 per cent more, if funds are available to purchase a continuous stop device which will not only provide all that is provided by the intermittent device, but will in addition provide a continuous light signal in the cab keeping the engineman advised at all times of the condition of the track ahead. This device will also apply the brake at any point in a block when conditions ahead change from "clear" to "danger" instead of performing this function only when passing a fixed point at the entrance to a block. Conversely while a train is traversing a "red" block, and conditions ahead change to "clear" the condition is immediately reflected on the locomotive, and the engineman is free to proceed at full speed. This will very often facilitate operation, whereas with an intermittent device the train under these conditions would be restricted throughout the block to that speed imposed by the indication at the entrance to the block.

Another substantial advantage provided by the continuous cab signal is that with its use the present rule requiring a train to stop at a "stop and proceed" automatic block signal becomes entirely unnecessary. The cab signal should show but two indications, viz., either green or red. As one of these indications is constantly confronting the engineman in the cab, the present rule should be changed to read: "A green cab signal indicates track ahead is clear and authorizes maximum speed. When cab signal changes to red, the speed of the train must immediately be reduced to that at which train can be stopped within distance track is seen to be clear."

It is essential that an audible cab signal, preferably an air whistle, be provided to sound when cab light signal changes from green to red, to attract the engineman's attention, should he be looking away when the change occurs.

Forestalling feature

The forestalling feature is a device incorporated in an automatic stop, so arranged that when operated by the engineman within a given period before and after the train control apparatus on the locomotive receives a stop indication from the wayside, a brake application is prevented, and the engineman is free to control his train and manipulate the brakes as his judgment dictates. If he fails to operate the forestalling device within the time allotted, the brakes will be applied and the train brought to a stop regardless of any action he takes. When Order 13413 was first issued by the Commission, the forestalling feature was prohibited. This made the installation of an automatic stop on nearly all large roads entirely out of the question, as a train would be brought to a stop every time a stop indication was encountered, regardless of the action of the engineman, and in numerous cases would have imposed two stops where one is now required. It would also have required doubling of hills by many heavy freight trains on roads where automatic block signals with tonnage signals are employed. This would have produced an intolerable operating condition, and many roads were thus forced to select devices embracing speed control at a vastly increased cost and involving complicated mechanism difficult to maintain. In its decision handed down in July, 1924, covering the hearing on the second Order 13413, the Commission modified its first order to the extent of allowing the use of the forestalling feature, but reserving the right to withdraw this permission at a future date if found necessary. This has been the means of saving large sums of money that would have been expended for speed control apparatus. The theory on which the forestalling feature had been objected to was that an engineman might forestall a brake application and run into collision with another train in a manner similar to cases which have occurred when automatic block signals were disregarded; but an automatic stop has been in service for more than ten years on one road and no accident has ever occurred that could be attributed to the use of the forestalling feature. It may be said that possibly no accidents would have occurred on that division if no automatic stop or train control had been employed, and there is, of course, theoretical basis for argument that a collision might occur through the abuse of the forestalling feature by an engineman, but it is difficult for us as practical men with years of locomotive experience to conceive that with a continuous cab signal an engineman would deliberately disregard a red light staring him in the face in the cab and proceed to collide with another train.

Speed control vs. automatic stop

Any train control apparatus on locomotives requires a high degree of maintenance, but with speed control added, this is increased. The experience of the writer has shown that of the maintenance troubles arising, a large proportion (probably 50 per cent) develop in the speed control mechanism. It has been shown that with properly trained men and intensive supervision, the stop apparatus, both electrical and pneumatic, can be maintained in good working order, but even with the highest degree of maintenance many troubles occur in the speed control apparatus, causing undesired stops and cutting out of the device en route. Numerous tests have developed that the lowest speed at which it is practical to establish the functioning of the speed control apparatus on long freight trains is 20 miles an hour; in other words, if it is set to impose a lower speed restriction it will apply the brakes when this speed is exceeded, and although intended to release the brakes and allow the train to proceed immediately the speed is reduced below the restriction, it does not so work out in practice and the train is brought to a stop. This also frequently occurs when the speed is set at 20 miles an hour. Analysis of all the collisions which occurred on one large railroad for 10 years past developed there was not one instance where an engineman had passed a stop signal and was aware he had passed it that the speed of the train at the time of the collision was greater than 15 miles an hour. With such a record it would be folly to expend the large sum required for the purchase of speed control apparatus, as well as to incur the heavy maintenance cost of and troubles involved in an apparatus which can only be expected to limit the speed of train to that which is substantially higher than those at which collisions occur under conditions which it is presumed to prevent.

Speed control is a beautiful theory, and many theoretical arguments can be advanced by technical men to prove its necessity, but when its functions are analyzed on a practical basis, it is difficult to justify its existence, except possibly in cases where unusually dense traffic prevails

and it is necessary to operate many fast trains on very close headway.

Elimination of wayside signals

With a continuous induction system, incorporating visual cab signals, there appears no good reason why wayside block signals cannot be dispensed with. Practically the only objection to this procedure is that in the event of failure of the electrical apparatus on the locomotive the engineman would be left without any indication whatever of track conditions ahead. The answer to this is that there are thousands of miles of track being operated safely and efficiently today without wayside signals of any kind, and with the remarkable development of continuous induction types of automatic train control during the past few years we have a right to expect them to function as reliably as automatic block signals. Even if more failures of this apparatus occur than with automatic block signals, an occasional train can surely be depended on to safely traverse a portion of a division without the aid of signal protection.

Split reduction vs. continuous reduction

Volumes have been written on the air brake action when the brake pipe reduction is brought about by the train control apparatus. On account of recommended practice covering manual manipulation of the brake valve requiring the application of the brakes to be made with a split reduction, chiefly to allow slack in long trains to bunch before the full application is accomplished, many air brake experts insist that the train control apparatus apply the brakes with a split reduction also. One of the most prominent train control manufacturers urgently recommends this feature. The incorporation of a split reduction feature further complicates an already complicated device. The Illinois Central made braking tests on heavy freight trains ranging in length from 63 to 102 cars at speeds of 8 to 38 miles an hour, and on ascending and descending grades. Tests 1 to 14 inclusive were made with continuous reductions, the brake pipe venting until the train came to a stop, which is the method usually employed with an automatic stop. Tests 15 to 29 inclusive were made with a 7-lb. initial reduction, followed in five seconds with a 17-lb. reduction, which is the method employed by one of the leading train control systems embracing speed control. It is extremely interesting to note that in none of these tests was a stop attended with a shock that could be termed severe.

The writer has also witnessed many other tests, with both split and continuous reductions with train control during the past three years, on ascending and descending grades, throttle open and throttle closed, and in no case did any damage result from a continuous reduction. In tests where the throttle was closed and the brake pipe reduction started at the same instant on freight trains of 100 or more cars at speeds of 10 miles an hour or less, slack ran in at the rear end with a severe shock with either a split or a continuous reduction. When the brakes were applied at any speed and the throttle held open to stop, the slack action was in no case severe.

In the light of these tests, and in view of the fact that with an automatic stop incorporating a forestalling feature, the brakes will very seldom be applied by the automatic train control apparatus. The additional expense and complications involved by the split reduction apparatus are not warranted. Where speed control is employed, the split reduction may possibly at times fulfill a useful purpose, as unexpected brake applications will be received more or less frequently.

Conclusions

When financial conditions permit the installation of the most desirable device, an automatic stop of the continuous induction type incorporating the following features is recommended:

1—Continuous visual cab signals.

2—An audible cab signal to attract the attention of the engineman to a change of indication from clear to danger.

3—So designed that the engineman, if alert, may forestall a brake application within a stipulated period of time.

4—Engineman to have an interval of approximately 10 seconds before to 10 seconds after the cab signal changes to "danger" in which to operate the forestalling feature.

5—If the engineman fails to operate the forestalling feature, a brake application will result and continue until the train is brought to a stop.

6—Brake pipe reduction to be at the same rate as a manual service, but to continue until train has come to a stop.

7—Apparatus to consist of the smallest possible number of parts to provide these functions and meet the requisites of the I. C. C.

As the modification of the first order by the Commission, following the use of the forestalling feature, means the saving of vast sums of money in installation and maintenance costs for the railroads compelled to install train control, and selecting automatic stops, and also provides for the least possible interference with the engineman in operating the locomotive in his charge, the members of this assoication can lend invaluable assistance by impressing as forcibly as possible upon the enginemen under their jurisdiction the extreme importance of using the forestalling feature only when they are certain no hazard is involved. If enginemen should make use of this invaluable feature indiscriminately or carelessly and this practice result in a serious collision, it is not unlikely that the Commission would withdraw the permission granting its use, which would force the application of speed control with its complications, troubles and excessive cost.

Discussion

A representative of the Michigan Central stated that this road has abandoned its 20-mile test installation of the continuous train control and is proceeding to install two divisions of the intermittent inductive train stop. He therefore wished to defend the decision of his road in such choice against the argument presented by Mr. Von Bergen. He said that the intermittent inductive type is simple, requires a minimum amount of change in the wayside signaling and meets the requirements of the Commission. He considers the wayside signals absolutely necessary and believes that the majority of locomotive enginemen are not in favor of eliminating wayside signals.

J. B. Stewart (M. P.) reported that the Missouri Pacific has a complete engine division in operation under train control of the intermittent inductive type which is operating with entire satisfaction. He therefore wished to take issue with Mr. Von Bergen as to any concerted approval of the continuous or any other type at this time Mr. Stewart explained that at certain locations on curves or on bridges speed restrictions are enforced by speed magnets which operate the train control to stop the train in case the speed is over 25 miles an hour.

E. Wanamaker (C. R. I. & P.) stated that the Chicago, Rock Island & Pacific has been operating a complete engine division under train control protection of the intermittent ramp type with speed control for the past 18 months and that results have been satisfactory in spite of severe winter weather.

L. F. Howard (Union Switch & Signal Company) stated that his company is prepared to furnish apparatus to give either the split reduction or the continuous reduction, whichever the railroad desires. On double track there may be the liability of accidents caused to other trains due to buckling of train where continuous reduction is used that might be eliminated by the split reduction. In explaining the desirability for speed control Mr.

Howard said that braking distance can be fixed only when speed is considered and that the function of speed control is to limit the speed on approaching the brake application point such that the train will be stopped in a fixed distance. It was also his contention that speed control is quite desirable in occupied blocks. In Mr. Howard's opinion the cab signal can be developed to be as reliable as the wayside signal. However, this function will depend on future developments.

C. A. Lyons (Regan Safety Devices Company) brought out that there are certain places such as in yard limits on bridges and in tunnels where train stops are undesirable and that such stops may occur with the continuous system but not with the intermittent system because the braking points are fixed in the latter system. He explained that with speed control the train can be continued in motion at a definite speed, thus facilitating movements and eliminating stops. Mr. Lyons answered one objection to the ramp by stating that notches can be cut in the aprons of spreaders, snow plows, etc., to clear the wayside ramps satisfactorily. If proper sized exhaust ports are provided Mr. Lyons stated that in his opinion continuous reduction will give satisfactory air brake operation on almost any road.

E. Von Bergen (I. C.) in closing the discussion on his paper, answered several of the points brought up. He agreed with the Michigan Central representative that wayside signals should not be eliminated if the intermittent train stop system is used. However, in his opinion many enginemen will prefer a cab signal to wayside signals if given their choice after experience with both. In reply to Mr. Lyons he said that in his opinion if conditions are such that the train should be stopped, the quicker it is stopped the better, regardless of the location and without waiting until a designated point is reached.

Results of improper handling of locomotive and air brakes

Assuming that good judgment and sound principles have been considered in making rules and laws governing the building as well as operation of brakes on trains, the first thing to consider is the maintenance of this equipment so that it will respond when desired according to laws and rules that were made to work with the builder, as well as to the operator's ideas and instructions.

If this is done, the next thing to consider is the good judgment of the engineer in the operation of the locomotive and brakes to avoid violent slack action in applying or releasing the brakes when slowing or stopping a train.

It is the opinion of the committee that with long freight trains many draw-bars and draft riggings are damaged and severe shocks in slack action (damaging the lading) result from closing the throttle abruptly applying the brakes on the engine at the same time as on the train before the slack has had time to adjust or bunch, and releasing the brakes while the train is in motion with the head end moving faster than the rear.

In connection with piston travel the commitete calls your attention to Table I, which shows the difference in cylinder pressure and effective braking power with piston travel of various lengths, as compared with that of eight-inch travel. Table II shows the equalization pressure in brake cylinders from four to twelve-inch travel with the respective brake pipe reductions.

The fundamental enemies of the modern air brake are uneven piston travel and leaks. Uneven piston travel causes a variation in every operation of the air brake system.

Table I gives the results of test made to show what is done in a service application with a ten-pound reduction of brake pipe pressure. As a matter of fact, the results actually obtained in service will be from two to three pounds lower than shown in the table on account of leakage, etc. (When the above tests were run there was no leakage and everything was air tight.) The effective braking power is that which would be delivered to the brake shoes for the cylinder pressure given. Assuming that the leverage is designed for 60 per cent braking power at 50 lb. pressure, this percentage being now recommended in freight service for steel cars or wooden cars with steel underframe. In practice eight-inch piston travel is usually taken as standard for freight service.

Table I

Piston travel	Cylinder pressure lb.	Effective braking power Per cent	Comparison with 8-in. travel Per cent	
4-in.	52½	63	130	greater
5-in.	41	49	78	greater
6-in.	34½	39	44	greater
7-in.	27½	33	20	greater
8 in.	23	27½		
9-in.	19	23	16⅓	less
10-in.	16	19	31	less
11-in.	13	15½	44	less
12-in.	11	13	53	less

The proper piston travel is that which will develop approximately 50 lb. cylinder pressure when the auxiliary

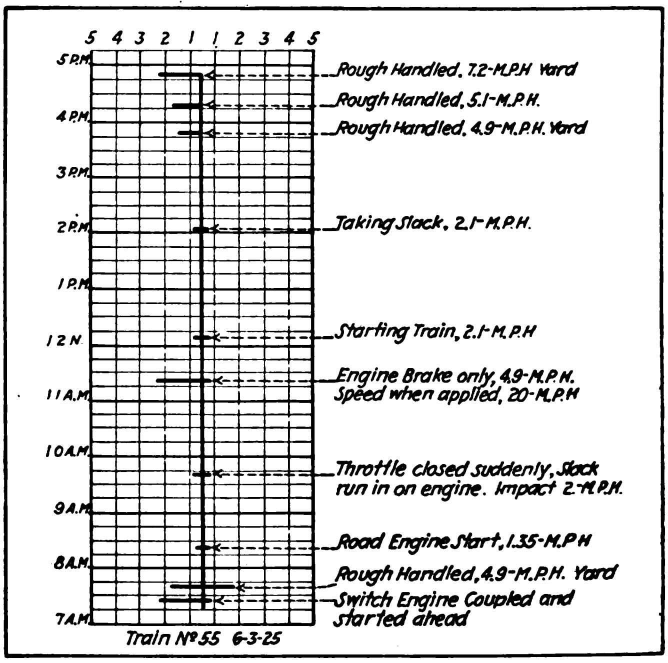


Fig. 1—Record of impact machine with 62-car train

and brake cylinder pressures become equalized from an initial brake pipe and auxiliary reservoir pressure of 70 lb. when a 20-lb. brake pipe reduction is made. This 50-lb cylinder pressure will then be the limit of a full service application, and should be obtained simultaneously on all cars. Table II shows approximately the pressure at which the cylinder and auxiliary reservoir above mentioned will become equalized for different piston travels, and the brake pipe reductions required to give this equalization.

Table II

Piston travel	Equalization pressure	Brake pipe reduction
4-in.	59 lb.	11 lb.
5-in.	57 lb.	13 lb.
6-in.	55 lb.	15 lb.
7-in.	55 lb.	16½ lb.
8-in.	51½ lb.	18½ lb.
9-in.	50 lb.	20 lb.
10-in.	49 lb.	21½ lb.
11-in.	47 lb.	23 lb.
12-in.	46 lb.	24 lb.

Particular attention should be given in this table to the large variation in brake pipe reduction, the short piston

travel requiring a smaller reduction and equalizing at a higher pressure than in the case of longer travel.

In proof of the committee's contention that 85 per cent of rough handling is done in yards, we call your attention to Fig. 1, which is a chart taken from a 62-car train. The impact machine was placed in the tenth car from the engine and it shows that 2.1 miles per hour was the greatest impact on the line of road, except that at 11:30 a.m. the engine brakes were used purposely to see just what the impact would be with a speed of twenty miles per hour and the slack gently bunched. Even with this light handling of the independent brake valve, the impact was 4.9 miles per hour, while the machine showed that the car was rough handled in both terminals.

In conclusion the committee wishes to call your attention to the freight claim expenditures (for 1924 on 95 per cent of U. S. and 65 per cent of Canadian mileage):

Damage due to rough handling	$9,584,984.00
Unlocated damage	8,273,312.00
Concealed damage	2,148,475.00
Freight train car repairs (1923 report for Class I Roads, U. S.)	153,509,170.00
A total of	$173,515,914.00

The report was signed by James Fahey, chairman, traveling engineer, N. C. & St. L.; N. Suhrie, road foreman of engines, Penna.; R. Hammond, road foreman of engines, N. Y., N. H. & H.; C. H. Dillinger, air brake supervisor, N. Y. C.; and H. W. Sefton, supervisor locomotive and fuel performance, C. C. C. & St. L.

Discussion

At the close of the reading of this report an extended discussion took place. One member questioned the need of automatic slack adjusters since if the piston travel is correct when a train leaves the terminal it will be the same at the end of the run save for a small fraction of an inch additional slack due to brake shoe wear. It was pointed out that after the first brake application the engineer feels the slack action of the train and must govern himself accordingly in future brake applications. In the main, the contention of the committee that most desirable brake action is secured when the slack is kept stretched and the brakes applied before the throttle is closed was upheld. H. H. Burns, Westinghouse Air Brake Company, agreed with a previous speaker in questioning the advisability of placing as much emphasis on piston travel as was done in the committee's report. While insisting that a constant effort should be made to improve the standard of air brake maintenance including recommended piston travel, Mr. Burns said that the improvement within the past year or two has been such that irregularities in brake action due to non-uniform piston travel are far less serious than those occasioned by the combination of loaded and empty cars in the same train with disproportionate braking power. Moreover, the drop in pressure at the end of a 100-car freight train, which may be as much as 15 lb., will occasion a greater variation in braking power between the front and rear cars of the train than would be caused by considerably more than the usual variation in piston travel.

Mr. Burns also commented strongly on the damage (often concealed) done by trying to spot locomotives for coal or water without uncoupling from heavy drag freights. He pointed out that while road foremen and sometimes two or three of their men may be able to do this successfully, by far the great majority of enginemen cannot spot a heavy tonnage train at a water standpipe or coaling station without unnecessary rough handling. The general conclusion was that no hard and fast rules can be adopted regarding this matter, which must be left more or less to the judgment of the engineman, depending on conditions. At the conclusion of the discussion the Association voted to adhere as closely as possible to the general rules laid down by the air brake companies for brake operation and in addition make brake applications with the slack stretched as recommended by the committee.

Appliances for lubricating locomotives

Until recently the hydrostatic lubricator of various designs had been the only medium used for applying oil, but with the advent of larger locomotives it has been felt that a device should be produced which would fulfill these functions more efficiently. With this end in view, the mechanical or force feed lubricators of various designs have been placed on the market, and have been applied to a considerable extent. Your committee has sent out a questionnaire to the membership with a view of securing information as to the degree of success secured from the application of the force feed lubricators; also, how their operation compares with the hydrostatic lubricators. The replies received would indicate that while a great number of those lubricators have been applied, they have not been in service long enough to secure definite data as to their efficiency as compared with the hydrostatic lubricators.

Each of the two types of lubricators has its separate merits and defects. For instance, by applying the hydrostatic lubricators to the large modern engines, it has been felt by some that because of the great length of the oil delivery pipes serious difficulties were being introduced in delivering the oil successfully to the valves and cylinders.

Not being able to secure any definite data comparing the hydrostatic and mechanical lubricators, the chairman of this committee will give his personal observation. We have applied mechanical force feed lubricators to our mountain type locomotives operating in heavy fast passenger service and have secured very satisfactory results. Certain defects were encountered, but with the experience we have gained these are readily overcome. The chief defect was choke valves leaking, which allowed steam to back up in the oil pipes and condense in the oil chamber. This condensation settled to the bottom and in some cases was of such a volume as to float the oil above the intake of the pump. This defect can be easily detected and remedied by the simple practice of opening the drain valve at the bottom of the lubricator and if water appears, this is an indication that a leaky choke valve exists and requires attention. Our staff has now been instructed and trained to watch this feature. The result is that this defect has now been practically eliminated. There are also instances where the lubricator apparently did not feed on one side. The cause of this was found to be choke fittings corroded and seized.

Some authorities claim that a lubricator should feed an amount of oil corresponding to the speed of the locomotive. This is not good reasoning, because the volume of oil required for lubrication is not always in proportion to the velocity, or to the area rubbed over. Especially is this so when the temperature of the rubbing surfaces is increased by some other agent than friction, which greatly reduces the viscosity of the lubricant and destroys the oil film in a very short time.

On this account the volume of cylinder lubrication would be regulated more by the cylinder temperature than by the area rubbed over. Assuming, then, that on account of occasional high water or bad water the oil film on the cylinder walls has been destroyed, how is this lubricating film to be restored if the volume of lubricant cannot be immediately increased? I might say that this film can be restored with the mechanical lubricator by lengthening the

cut-off, which generally would come in line when a condition of this kind arises. With a hydrostatic lubricator it would be necessary for the locomotive engineer to readjust the feeds.

The oil film is also often destroyed by the admission of front end gases to the cylinders when they are at high temperatures, and it must again be built up by the admission of a little excess oil, because the regular feed only supplies the necessary amount to replace the regular wear of the film, and cannot be expected to build up a new film. The lubricator must be equipped so its capacity can readily and quickly be adjusted to meet requirements.

Among the replies received to the questionnaire sent out was one from the London Midland and Scottish Railway, stating that this railway has 513 locomotives equipped with mechanical lubricators. They have no locomotives equipped with either the two-feed or the four-feed lubricators for oiling valves and cylinders, but a large number of their engines are fitted with eight-feed mechanical lubricators, and they also have three-cylinder compound passenger engines fitted with twelve-feed mechanical lubricators. In regard to the type used, they state that the mechanical lubricator used is of their own design, each oil supply being fed by its own pump unit. Regarding tests conducted between mechanical force feed and hydrostatic lubricators, they state that they have fitted some engines with hydrostatic lubricators, but prefer the mechanical lubricator.

One road uses graphite lubrication

The talk on lubrication of valves and cylinders so far has had to do with valve oil and of different methods of supplying it to valves and cylinders, but at least one large system has secured some very good results from the use of dry graphite for lubricating valves and cylinders. This graphite is prepared in the form of solidified cakes and is fed by what is known as a pendulum graphite lubricator. The magazine containing the graphite is situated on top of the boiler and back of the smoke-stack. The natural side motion of the locomotive while running causes the pendulum to swing over the cakes of graphite and dusts or scrapes off a small amount of graphite at each swing. The graphite scraped off passes through a pipe into the superheater header and extends to the valves and cylinders.

While the dry method of lubricating valves and cylinders has not been brought into use to any considerable extent, it is nevertheless the opinion of the committee that it offers certain advantages, and we would strongly recommend that this feature of lubrication of valves and cylinders be gone into as thoroughly as possible.

The report was signed by A. N. Boyd, chairman, road foreman of engines, C. N.; W. E. O'Brien, road foreman of engines, B. R. & P.; C. H. Holdredge, district road foreman of engines, S. P.; J. W. Wells, road foreman of engines, N. Y. C. & St. L.; and G. C. Jones, division road foreman, A C. L.

Discussion

The discussion of this report indicated that mechanical lubricators are now being used in considerable numbers on many of the roads and are giving good results. One of the members expressed the sentiment that most of the minor defects common to earlier types of mechanical lubricators have now been remedied and the installation of this device will solve many present lubrication difficulties. On long runs over two or more divisions there is no possibility of the first crew using more than its share of the oil in the lubricator as a certain fixed amount is fed to the valves and cylinders for every revolution of the driving wheels. The lubricator feed is set at the time of shopping the engine and cannot be changed without the authority of the road foreman or master mechanic. It is outside of the control of the engineman except in case of emergency when, to make necessary adjustments, he must break a seal.

A representative of the B. & O. said that mechanical lubricators require little maintenance except the pipes which are subject to breakage by vibration unless the lubricators are properly located with regard to this limitation. Experience seems to indicate that the back valve head is the best place. Discussion at the convention brought out the fact that mechanical lubricants can be used for delivering oil to practically any part of the locomotive, several roads using the various feed lines to air compressor, feed water pump and to the guides. In general, the advisability of a mechanical feed to the air compressor was questioned because the compressor is usually working hardest when the locomotive is still and no oil being delivered. It was testified that to meet this condition at least one of the mechanical lubricators has provision for feeding by hand, there being the objection, however, that operation of the hand wheel forces oil to all the feeds.

The possibility and advisability of setting the lubricator feeds to give ample oil while breaking in a new locomotive was emphasized, the feed later being reduced by proper authority as conditions make it permissible. E. Von Bergen, Illinois Central, said that general experience fails to show whether it is best to lubricate locomotives through the valves or the cylinders, good results have been obtained both ways. He personally believes that a majority of the oil should be delivered to the cylinders, and the Illinois Central practice is to supply 25 per cent to the valves and 75 per cent to the cylinders. Some of the members testified just the reverse, that they delivered 75 per cent to the valves and 25 per cent to the cylinders. One of the members commented on another advantage of the mechanical lubricator in that it permits locomotives to be hauled dead without taking down the rods and blocking the crossheads.

Election of officers and other business

At the concluding session of convention, the following officers were elected for the year 1926: President, J. N. Clark, Southern Pacific; first vice-president, J. B. Hurley, general road foreman of engines and fuel supervisor, Wabash; second vice-president, J. D. Heyburn, master mechanic, St. Louis-San Francisco; third vice-president, James Fahey, traveling engineer, Nashville, Chattanooga & St. Louis; fourth vice-president, Ralph Hammond, traveling engineer, New York, New Haven & Hartford; fifth vice-president, A. N. Boyd, traveling engineer, Canadian National. David Meadows, Michigan Central, was re-elected treasurer of the association. W. O. Thompson, New York Central, is life secretary.

The by-laws of the association were amended to provide for an increase in size of the executive committee from 12 to 18 members, the following new members being elected: J. N. Nicholson, fuel engineer, Atchison, Topeka & Santa Fe; D. R. Sweeney, traveling engineer, Chicago, Burlington & Quincy; A. White, general road foreman of engines, Southern; M. A. Daly, general fuel supervisor, Northern Pacific; W. L. Robinson, superintendent of fuel and locomotive performance, Baltimore & Ohio; J. E. Bjorkholm, assistant superintendent of motive power, Chicago, Milwaukee & St. Paul, and D. I. Bergin, road foreman of engines, Wabash.

As a Means of stopping leaks that develop in containers in transit, the Freight Claim division of the American Railway Association suggests the use of soap. It has been found that soap has been used successfully in garages to stop gasoline leaks, for it does not dissolve in gasoline or heavier oils, melts very slowly in water, and resists some acids.

An effective letter filing system

Method of filing correspondence numerically by classification—Letters located quickly whether referred to in reply or not

By Beno Farenwald

Night enginehouse foreman, Chicago, Milwaukee & St. Paul, Avery, Idaho

THE correspondence filing system described in this article has been used for two years in the office of the master mechanic of the Chicago, Milwaukee & St. Paul at Deer Lodge, Mont., having there demonstrated both its simplicity and effectiveness. The system consists of a classification of correspondence in such a way that each figure in the file number represents a name or classification.

In developing this system it is necessary to have a fairly definite idea of the nature of the correspondence handled and then pick out the most important differences in the correspondence and number them from 1 to 9. In like manner make a second division to represent the second digit and continue until you have enough digits and separations to suit the needs. It is not necessary to assign completely each figure of the classification at first; in fact it is best to assign only figures as there is immediate need for them.

Suppose it is desired to build up a filing system for a railroad mechanical office, with steam and electrical power and all other special equipment under one jurisdiction: The first step is to separate the major differences in the correspondence, possibly numbering steam locomotives (1), electric locomotives (2), gas electric equipment (3), special equipment such as steam shovels, ditchers, etc., (4), power plants (5), roundhouses (6), heavy repair shops (7), labor (8), general, or anything which cannot be classed under any of the above heads (9). The foregoing separations will then represent the first figure in the proposed file number, and in like manner, a second separation can be made as follows: Material (1), machinery (2), lubrication (3), coal (4), fuel oil (5), electric power (6), additions and betterments (7), wrecks (8), general (9). Then for the third set of figures, subdivide into: Reports (1); investigations (2), instructions (3), agreements (4), permits (5), federal laws (6), accidents (7), train delays (8), general (9). The fourth separation might be: Timekeeping (1), pay checks (2), accounting (3), enginemen (4), shopmen (5), other employees (6), discharged employees (7), general (8), unassigned figure (9).

In filing letters the key to the correspondence files would be grouped as shown in Table I, so that a file number can be given each letter quickly, after it has been read by the chief clerk or file clerk.

In addition to the classification in Table I another division which will classify more specifically is the use of a letter on the end of each file, corresponding to the first letter of the most important factor of the letter.

Suppose we now want to file some correspondence in reference to a compressor of an electric locomotive. This would resolve itself into 2298-C. In like manner a letter in reference to a labor agreement would be filed 8948-A. Correspondence in reference to a roundhouse fire would be 6998-F.

Table I

1st Digit of File	2nd Digit of File	3rd Digit of File	4th Digit of File
(1) Steam locomotives	(1) Material	(1) Reports	(1) Timekeeping
(2) Elec. locomotives	(2) Machinery	(2) Investigations	(2) Pay checks
(3) Gas electric equipment	(3) Lubrication	(3) Instructions	(3) Accounting
(4) Special equipment	(4) Coal	(4) Agreements	(4) Enginemen
(5) Power plants	(5) Fuel oil	(5) Permits	(5) Shopmen
(6) Roundhouses	(6) Elec. power	(6) Federal laws	(6) Other employees
(7) Heavy repair shop	(7) Additions and betterments	(7) Accidents	(7) Discharged employees
(8) Labor	(8) Wrecks	(8) Train delays	(8) General
(9) General	(9) General	(9) General	(9) Unassigned

Letter index box or folder also required

The best method of handling this filing system is to make two copies and attach one to the main file, the other being put in a letter index correspondence box or folder corresponding to the first letter of the person the letter is addressed to. A new letter index box should be used every month or as often as necessary. The monthly system generally gives the most satisfaction. The file number should be on each carbon copy as well as on the original letter. The purpose of putting the second copy in the index box is to interlock the files for protection against replying letters giving the wrong file number or not mentioning the file number, but referring to the date of the letter. In this event the procedure would be to go to the box file for the month referred to and under the letter as previously explained find the letter of the date referred to; and obtain from it the proper file number. With this file number in mind go to the main file and obtain the correspondence desired, and pin the entire correspondence together. The file is now ready to be passed to the correspondent. The box index letter should never be taken out of its place unless absolutely necessary, as this

The type of filing system in use has an important bearing on office efficiency

is the interlock which protects against replying letters with an incorrect or no file number. If neither date or file number are given, then the correspondence must be classified until the proper file is obtained. This, however, is seldom necessary where a conspicuous red letter stamp at the top of the outgoing letter requests that (In reply please refer to file ——).

Disposition of dead files

After several years of files have accumulated a great many dead files in the filing cabinet can be permanently filed away in the record room. In order to expel dead correspondence from the files it is only necessary to put a hypen between the new file's first and second digit as 1-873-A. Build the new files as previously, and bring the live correspondence over into the new files as it comes up, leaving the remainder in their folders until such time as the live correspondence has been transferred into the new files. The old files can then be filed away in the record room and need only be brought out when something comes up of a very old date.

The disadvantages of this particular system are:

1—The above filing system in rare cases allows two different files to be put away under the same file number. However, there is always a relation between the letters in the same file folder. If files pertaining to each are always kept pinned together no trouble will be experienced.

2—A separate card reference must be kept to trace letters which have not been answered in the time desired.

3—Two copies of each letter must be made, but bearing in mind that it takes no longer to make two copies than it does one, except where the stenographer needs to use an eraser a great many times, the only objection is the exta sheet of paper needed. In view of the fact that very cheap paper can be used for the carbon copies, this is not a serious objection.

The advantages of this system are:

1—The file number can easily be put on the outgoing letters.

2—This system can be installed any time.

3—Obsolete files can be eliminated at any time.

4—Any one can learn to operate the system quickly.

5—This method has an interlocking system which can be operated quickly.

6—This method groups allied correspondence close together.

7—By allowing unassigned numbers vacant new subjects can be assigned numbers.

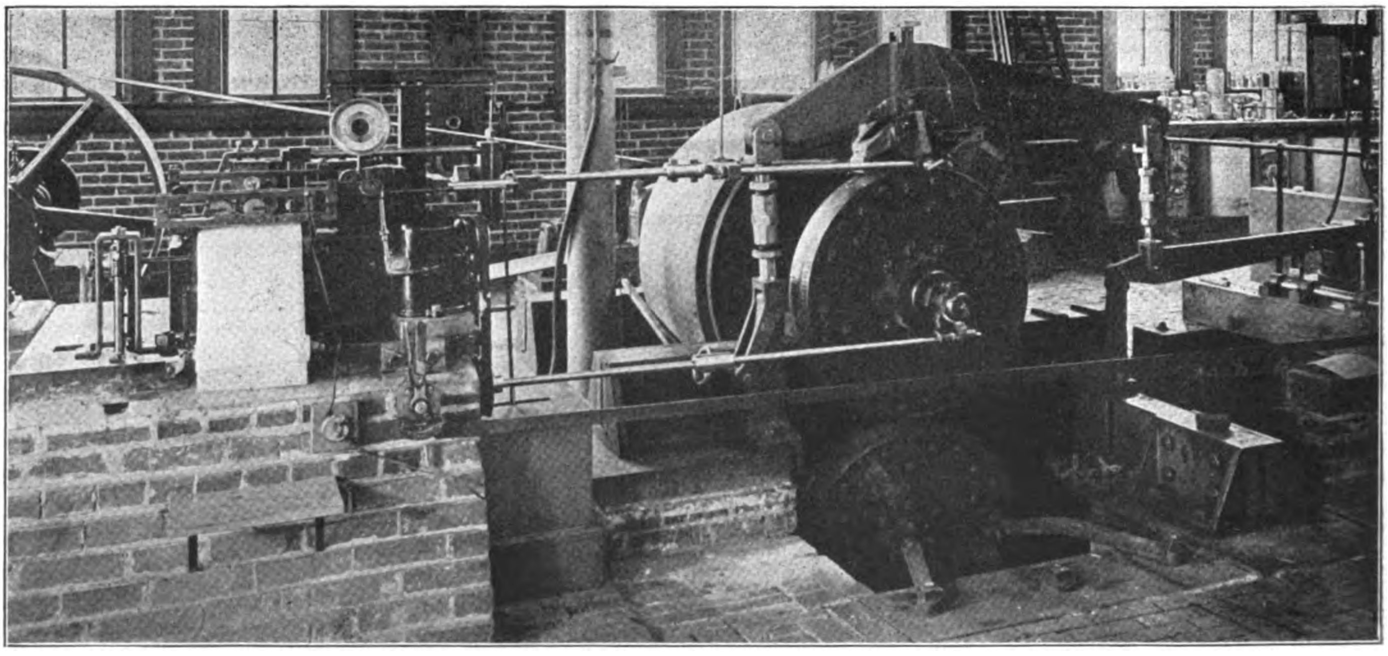
231,088 files are possible

Some idea of the available file numbers can be obtained from a study of the combinations that can be made by four digits of figures whose numbers lie within 9,999 and 1,111 or a sum of 8,888. Then the 26 letters in the alphabet make a possible of 26 times 8,888 or 231,088 possible files.

With 231,088 possible files, the possibilities of such a system can easily be understood. This system can be used by an entire mechanical department. The highest officer in this department need only assign various prefix letters to each subordinate officer. Any file originated by the highest officer will have his prefix, and in like manner files originating from subordinate officers will have theirs.

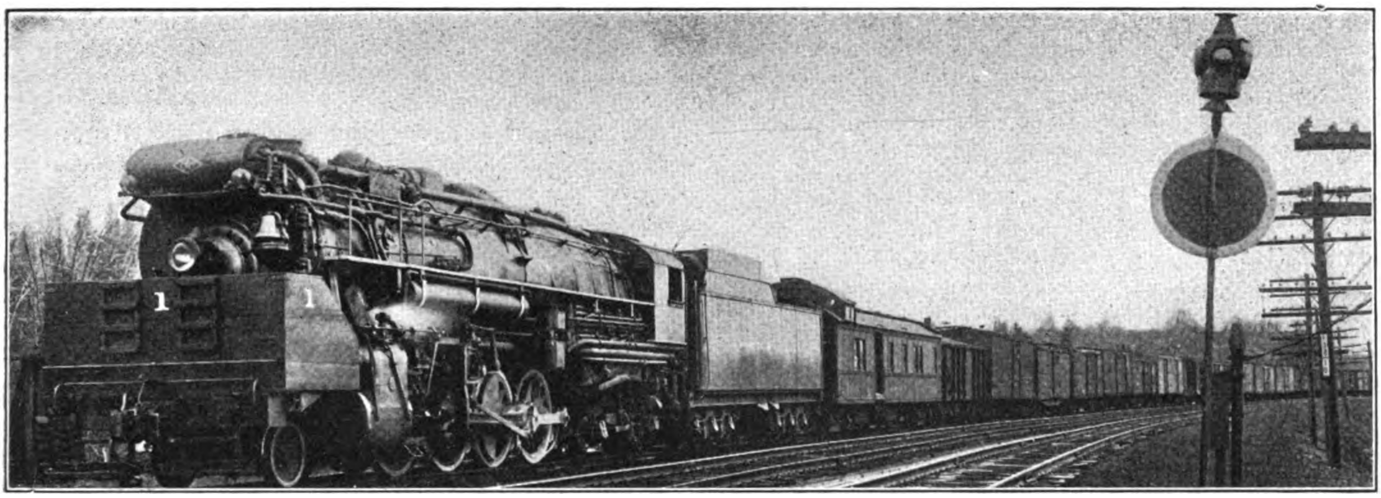
A mechanical officer whose duties compel him to write letters while traveling can do so by using the classification as a guide, and it will not interfere with his main office, even if he does not classify exactly as his file clerk does in the main office. The only difficulty that this may at times bring about is that the interlock system of ascertaining the file number by classification, which should only be used as a last resort, might not be as efficient. However, this is not a serious objection, and the other advantages gained by being able to file while on a business or inspection trip will more than offset this disadvantage.

This filing system affords an easy method of naming all correspondence quickly; the name is a number which, when referred to by the replying letter, automatically tells where to find the file. In the event that the file number is not referred to, several different quick methods can be applied to ascertain the proper file number.



Brake shoe testing machine installed at Purdue University by the Master Car Builders' Association in 1898

More than 500 brake shoes have been tested for wear and coefficient of friction since its installation. It is available for use at any time for investigation work by the Mechanical Division of the American Railway Association



The locomotive and a test train on the Albany division of the Boston & Albany

2-8-4 locomotive tested on B. & A.

Tests show satisfactory performance of new features of construction—Develops high fuel economy

By F. A. Butler

Superintendent motive power and rolling stock, Boston & Albany

ON page 267 of the May, 1925, issue of the *Railway Mechanical Engineer* there appeared a description of the new 2-8-4 type locomotive which was built by the Lima Locomotive Works, Inc., and placed in service on the Boston & Albany in February, 1925. In this article mention was made of the fact that the locomotive was undergoing tests in service, from which data would later be available. This article contains a summary of the results obtained in those tests.

This locomotive, which was designated as No. 1, was received at the Boston & Albany enginehouse at Selkirk, N. Y., on February 18, 1925. Two days later it was placed in regular freight service on the Albany division of that road and after a short period in regular freight service, test apparatus was applied at the West Springfield shops. The first test trip with the dynamometer car was run on March 28, 1925.

Test equipment

The test equipment included New York Central dynamometer car No. X-8006. Indicators were placed on the cylinders of the locomotive and gage glasses were applied to the corners of the tank to measure the water. The tank was calibrated by weighing water in a barrel mounted on platform scales on top of the tank. A slope bottom coal box mounted on platform scales was applied to the tender for measuring coal.

Steam gages were applied at the dome, to the saturated side of the superheater header, to the superheated side of the superheater header, to the steam chest, to the exhaust passage, to the steam space of the feed water heater, to the feed water line at the boiler check, to the steam line to and to the exhaust line from the locomotive booster.

Thermometers were applied to both steam pipes close to the steam chest and to the exhaust passage on the left side. Thermometers were also applied in the tender tank, in the water line to the feedwater heater, in the water line from the feedwater heater, in the exhaust steam line to the feedwater heater and in the condensate line from the feedwater heater. Pyrometers were applied to the superheated side of the superheater header and in the smoke box.

Provision was made to read the draft in the firebox,

Boiler performance

Test number	Duration of test hrs.	Dry coal per hr.	Dry coal per sq. ft. grate per hr.	Equivalent evap. per hr.	Equivalent evap. per lb. dry coal per hr.	Degree superheat at steam chest	Boiler eff.	Temp. steam in superheater header	Smokebox temp.	Draft front of diaphragm	Draft back of diaphragm	Draft firebox	Pressure at dome	Pressure at steam chest
25-51-10	3.48	5,427	54.27	57,171	10.534	205	72.75	652	569	5.22	3.46	0.67	227	208
25-51-12	3.22	4,871	48.71	54,273	11.140	194	78.49	650	571	5.43	3.58	0.76	224	209
25-51-14	3.33	4,112	41.12	49,203	11.966	190	83.63	637	543	3.90	2.61	0.70	227	195
25-51-16	3.13	4,730	47.30	53,729	11.360	195	81.66	639	556	4.44	2.38	0.83	226	202
25-51-18	2.82	4,957	49.57	61,729	12.452	216	89.51	660	577	4.63	3.24	0.78	224	204
25-51-20	2.87	5,420	54.20	65,343	12.034	213	87.84	663	562	5.30	4.05	0.90	231	211
25-51-22	2.95	6,423	64.23	69,320	10.790	236	75.25	672	599	6.70	4.83	1.04	231	211
25-51-24	2.83	5,597	55.97	63,111	11.277	220	77.86	665	585	5.15	3.42	0.69	224	203
25-51-26	3.46	5,856	58.56	63,333	10.816	210	77.60	659	582	5.59	3.82	0.69	216	201
Average	3.12	5,266	52.66	60,690	11.370	209	80.5	655	571	5.15	3.49	0.78	225	205

in front of and in back of the diaphragm. A summary of the data collected is given in the tables.

Operating conditions

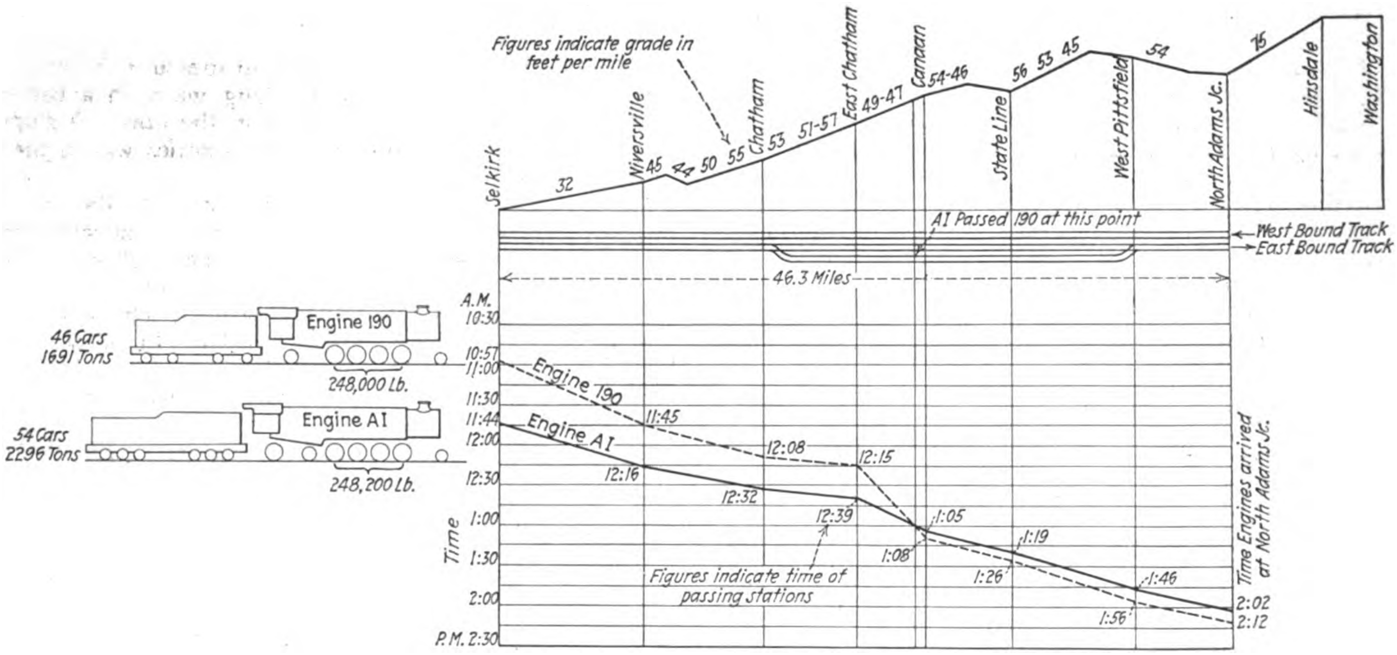
The Albany division is between Selkirk, N. Y., and Springfield, Mass., a distance of approximately 100 miles. The tests were run east bound from Selkirk to Washington, which is at the top of the grade, a distance of 60 miles. A condensed profile of the line is included which also contains certain operating data as well as the profile. The Albany division has many curves, but no attempt has been made to show these on the condensed profile.

Engine performance

Test number	Ave. working speed	Ave. cut-off, per cent stroke	Ave. I. hp.	Dry coal per I. hp. per hr. inc. auxil.	Dry coal per I. hp. per hr., exc. auxil.	Steam per I. hp. per hr., inc. auxil.	Steam per I. hp. per hr., exc. auxil.	Ave. drawbar pull	Ave. dynamometer hp.	Dry coal per d. hp. per hr., inc. aux.	Dry coal per d. hp. per hr., exc. aux.	Steam per d. hp. per. hr., inc. aux.	Steam per d. hp. per. hr., exc. aux.	Machine eff. of locomotive	Thermal eff. of locomotive
25-51-10	13.25	46.0	1,795.5	3.02	2.67	23.46	20.58	35,350	1,399.7	3.88	3.41	30.10	26.41	82.4	4.67
25-51-12	15.76	41.5	1,835.4	2.66	2.36	21.87	19.41	31,150	1,310.8	3.71	3.30	30.64	27.18	79.7	4.98
25-51-14	14.42	35.2	1,706.0	2.68	2.37	21.42	18.60	29,500	1,179.1	3.49	3.03	30.99	26.90	77.4	5.07
25-51-16	15.63	41.0	1,763.5	2.68	2.37	22.64	19.94	32,450	1,354.2	3.50	3.08	29.48	25.97	79.7	5.39
25-51-18	18.18	39.5	1,826.9	2.71	2.34	24.91	21.55	31,216	1,515.2	3.27	2.83	30.04	25.98	82.9	5.77
25-51-20	17.62	45.0	2,007.1	2.71	2.41	23.98	21.38	36,000	1,693.6	3.20	2.86	28.41	25.33	83.2	5.99
25-51-22	16.84	48.5	2,367.8	2.72	2.41	21.47	19.09	38,067	1,711.6	3.75	3.34	29.70	26.40	80.6	4.88
25-51-24	18.03	43.0	2,077.3	2.69	2.42	22.38	20.06	33,300	1,603.1	3.49	3.13	29.00	25.99	79.2	5.19
25-51-26	14.79	54.0	1,934.9	3.03	2.62	24.12	20.85	39,650	1,565.8	3.74	3.23	29.80	25.76	83.4	5.03
Average	16.16	43.7	1,923.7	2.76	2.44	22.92	20.16	34,076	1,481.4	3.56	3.13	29.72	26.21	80.2	5.22

Under normal conditions the volume of freight and passenger traffic closely approaches the capacity of the track. Therefore, any increase which can be effected in the size of the train unit and the speed of operation relieves this condition.

Nine reliable tests were made between March 28 and April 18. During this period the weather conditions were variable and at times the condition of the rail was poor, as light snows were encountered. The average atmospheric temperature for one complete test was 43 deg. F. The tests were run under normal operating conditions and the results, therefore, reflect the performance of the locomotive in regular service.



Profile of the Albany Division, showing the comparative test run of locomotive No. 1 and a Mikado locomotive

All figures are given as average over the test division including the effect of all variations of power output, from the maximum to the minimum which go to make up the average, and hence are valuable as data which can be used to make comparisons and predictions in regular train operation. For this reason no attempt was made to correct for grades and curves where these factors might enter into the final results.

Average boiler and engine performance

The efficiency of the steam generating plant ran from 72.75 per cent to 89.51 per cent, the average of all runs being 80.5 per cent. The relation between coal rate and efficiency is shown in one of the diagrams. This high average was the direct result of the large grate area and firebox and the boiler equipment. The large grate area gave an average coal rate per square foot per hour of 52.66 lb. for all runs. The large firebox and the Type E superheater which permitted a maximum gas area through the tubes and flues, together with the feedwater heater produced an average evaporation of 8.13 lb. of water per lb. of coal as fired. The equivalent evaporation per lb. of dry coal was 11.37 lb., average.

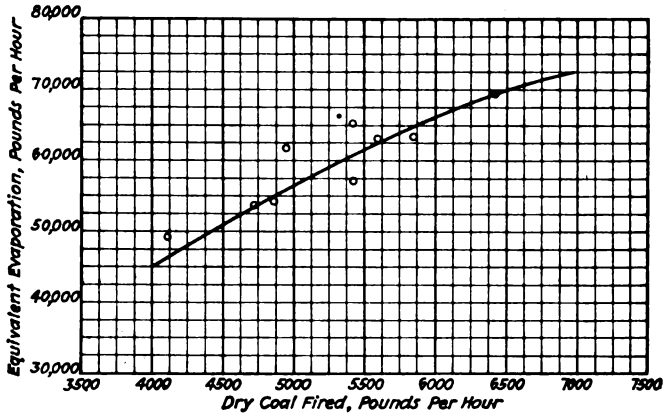
The smoke box temperatures clearly reflect the ability of the firebox and boiler to absorb heat. These figures ran from 543 deg. F. to 599 deg. F.

The boiler pressure of 240 lb. per sq. in. and the limited cut-off enabled this engine to produce an average of 1923.7 indicated horsepower with an average cut-off over the test division of 43.7 per cent. This resulted in an average water rate per indicated horsepower-hour of 20.16 lb. The coal per indicated horsepower-hour was 2.44 lb., average, with a maximum of 2.67 lb. and a minimum of 2.34 lb. The maximum cylinder horsepower recorded was 3,675.

The dry coal per dynamometer horsepower-hour averaged 3.13 lb., with a maximum of 3.41 lb. and a minimum of 2.83 lb. The maximum drawbar pull was 76,800 lb., of which the booster produced 11,800 lb. The maximum sustained drawbar horsepower recorded was 3,240.

The locomotive as an operating unit

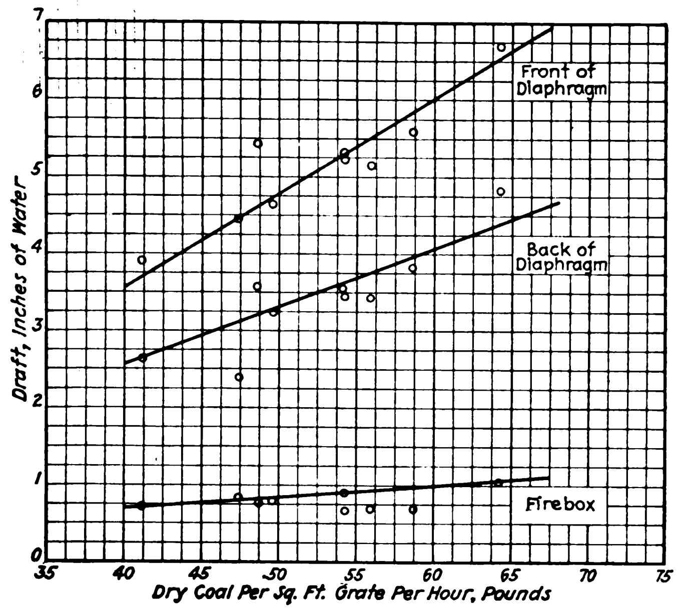
Reference was made in a previous paragraph of this article to the severe operating conditions on this division



The relation between boiler output and coal consumption

due to the great number of trains to be moved and the relief it is possible to obtain by increasing the size of the train unit and the speed of operation. To effect this requires an increase in gross ton-miles per hour per locomotive, which in turn means a corresponding increase in dynamometer horsepower per locomotive.

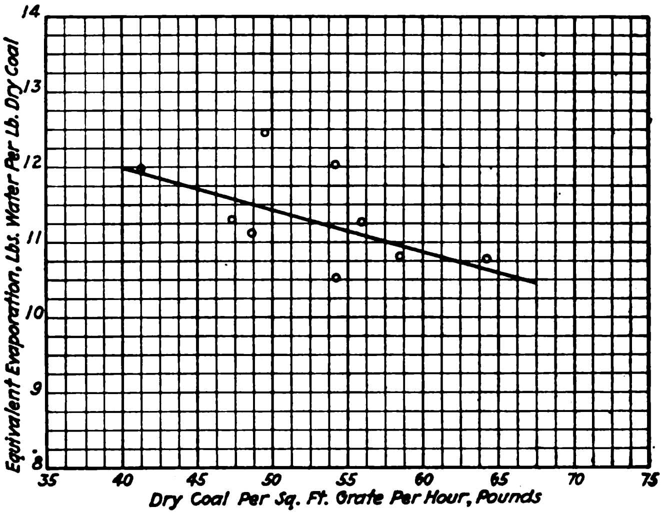
Probably the clearest comparison in this regard between the 2-8-4 type engine and the Mikado type now used on the Albany division (the principal dimensions



Variation of the coal rate in relation to the draft

of which were compared with those of the 2-8-4 locomotive in the description of the latter in the May, 1925, *Railway Mechanical Engineer*, was the test run of April 14, 1925. This comparison is shown in the diagram below the drawing of the profile of the division.

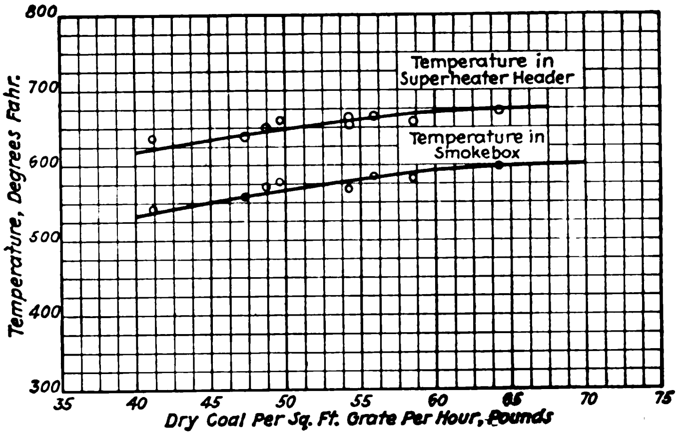
On this day Mikado engine No. 190 started from Selkirk with a manifest train of 46 cars, 1,691 tons, 47 minutes ahead of the 2-8-4 type class A-1 which had 54 cars, 2,296 tons. Both trains ran without delays, the A-1 overtaking the No. 190 at the point shown on the diagram. At Chatham, No. 190 took the outside track so that at the time of passing the two trains were running side by side on parallel tracks under exactly the same conditions. Between East Chatham and Canaan is a difficult part of the line, with many curves and a heavy



The relation between the coal rate and the rate of evaporation

grade, the severity of this part of the line in comparison with other sections having similar average grade conditions not being adequately shown by the profile.

This run may be taken as a fair comparison of the relative ability of the two engines to move freight over the line. The uniform speed of the 2-8-4 type locomotive over the test division is noteworthy as indicated by the uniform slope of the time curve.



Relation between the coal rate and superheater and smokebox temperatures

The following data compiled from the test result of the two locomotives is a comparison on the basis of gross ton-miles and fuel.

Average dynamometer horsepower, which is proportional to gross ton-miles per hour

Average lb. dry coal fired per hour	A-1	Mikado	Per cent increase A-1 over Mikado
4,000	1,200	†	...
4,500	1,350	†	...
5,000	1,480	1,200	23.5
5,500	1,600	1,250	28
6,000	1,750	1,320	33
6,500	*	1,420	...
7,000	*	1,550	...
7,200	*	1,650	...

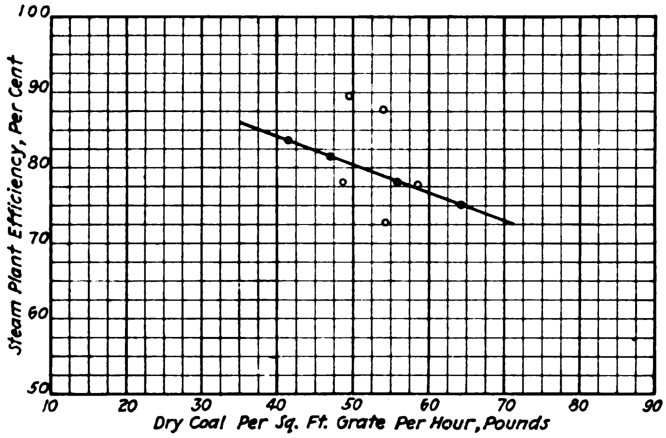
*The A-1 never reached these rates of firing.
†The Mikado never ran at as low rates as these during the tests.

Further details of the test data are shown in the tables

of engine and boiler performance. Charts showing a number of pertinent relationships with respect to the coal rate per sq. ft. of grate per hour, the coal and steam consumption rates and the thermal efficiency, calculated from this data, are also presented.

Performance of the new features of construction

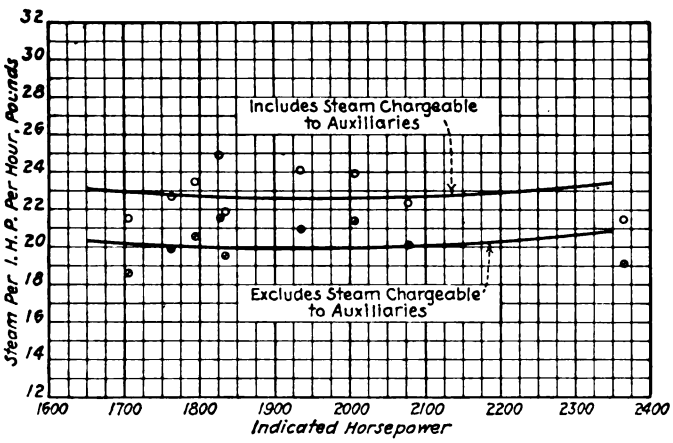
Many new features of construction were incorporated into the design of the Class A-1 locomotive. As these are vital elements in the economic performance of the



The efficiency of steam generation in relation to the coal rate

engine, their operation was noted with special care to determine their adaptability and usefulness under service condition. The principal new features, which were described in detail in the May, 1925, issue of the *Railway Mechanical Engineer* are the compensated limited cut-off in the cylinders, the cast steel cylinders, the articulated main rod drive, the articulated trailing truck and the large grate area.

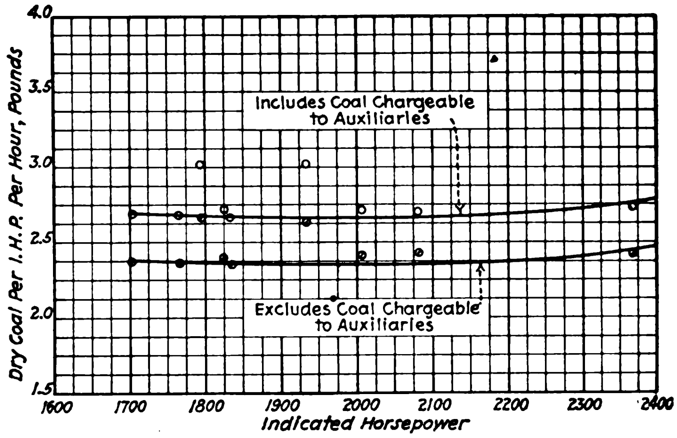
Trials were run to determine the best point of cut-off consistent with prompt starting under the worst conditions of rail, grade and position of the cranks. It was



Steam consumption in relation to indicated horsepower output

found that 60 per cent maximum cut-off best met this condition. With this cut-off an indicated tractive force of 69,400 lb. was obtained at slow speeds. The indicator cards gave a very even turning moment with the result that with this tractive force, giving a factor of adhesion of 3.58, there was no more tendency to slip than there would be with a full stroke cut-off engine, having the same driving wheel load and developing 63,500 lb. tractive force. Prompt starting was secured under all conditions.

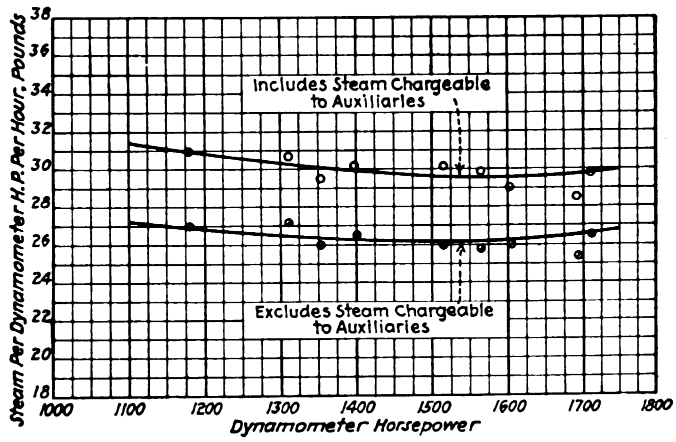
With respect to the cylinders, the only comment which can be made after a limited time of operation of about three months is that the cylinders showed no signs of



Dry coal consumption per indicated horsepower

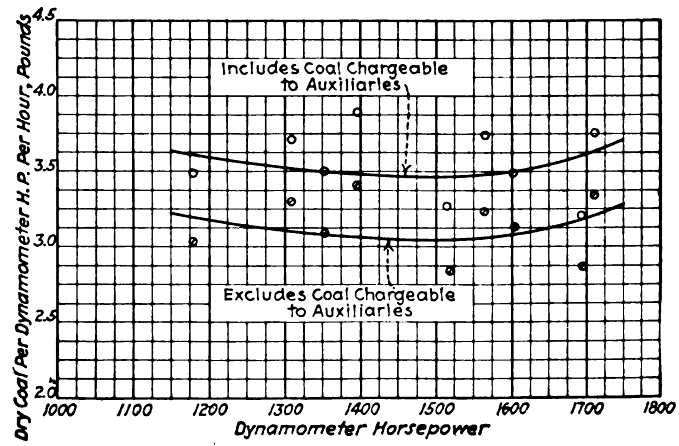
weakness and that all the joints of the exhaust passages remained tight. In fact these joints were never touched during that time.

No trouble was developed with the new type of rod



Steam consumption in relation to dynamometer horsepower output

drive, the same bearings with which the rods were first equipped remaining in place throughout the test. No hot pins or main boxes trouble developed, although with

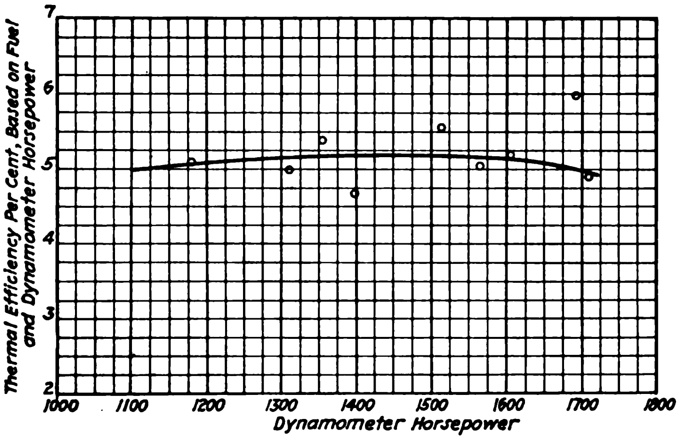


How the rate of coal consumption varied with the dynamometer horsepower output

240 lb. pressure the piston thrust is 148,000 lb. Measurements of the wear on the main and rear boxes were made to determine whether the piston thrust was being dis-

tributed by the rod drive over two pairs of boxes. These measurements showed almost exactly the same horizontal wear in the back as in the main brass thus indicating the correctness of the theory that this rod drive distributes the thrust over two pairs of wheels. Final confirmation of this, however, can only be obtained after more extended service.

No trouble of any kind was experienced with the tracking or operation of the articulated trailing truck and it seemed to adapt itself very well to the track conditions. The engine rode steadily up to the highest operating speeds which the service required. Particular comment



The thermal efficiency at the drawbar

is made upon the large ash pan and the ease with which it can be dumped. The accessibility of the booster and stoker is also worthy of note from a repair and maintenance standpoint.

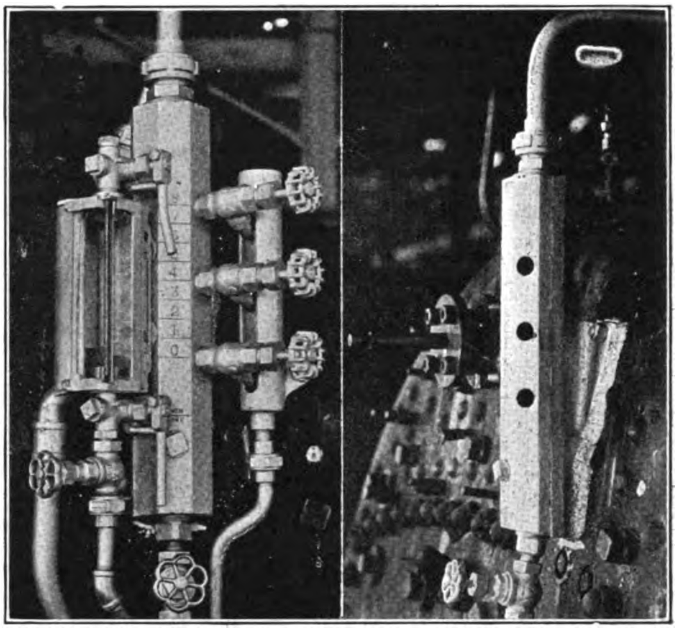
Observations were made to determine if under conditions of very light work proper combustion would be supported over the large grate area. No trouble from this cause was experienced and rates of firing as low as an average of 41 lb. of coal per sq. ft. of grate per hour over the test division were recorded.

Compact cast steel water column

IN view of the interest being shown by the railroad field in the question of satisfactory water columns, the accompanying details of the L. & C. cast steel water column, which has become standard on the Canadian National, should offer useful suggestions to those working on this problem. Up to the present time over 300 locomotives have been equipped with this column. It is of a compact and rigid design and is welded directly to the backhead of a boiler without the use of separate brackets. This method keeps the application close enough to the face plate to give the engineer an unobstructed view of all gages. This condition, together with the elimination of bolts or studs for securing it to the boiler, is a particular feature of the L. & C. column. The welding pad which is cast integrally with the column permits over 30 in. of welding and this pad is so designed as to fit on to a locomotive boiler without covering any tee-iron rivets.

The first L. & C. columns applied had a bore of 2 in., but later applications were given a 3-in. diameter bore. The bottom connection into the boiler, which is made of cold-rolled brass, is provided with a ¾-in. opening and is applied in such a manner as to provide additional fastening to the boiler. By removing the plug in the face of the column, the bottom connection can be readily cleaned.

The water glass mountings are applied directly into the column in such a position that they project the least possible distance beyond its face while still being easily



General view of water column and method of welding to backhead

visible to both the engineman and fireman. In the case of the Canadian National mountings, they project only 2½ in. beyond the face of the column.

FREE AND EASY.—The following account of an accident caused by an explosion in an empty tank car, published in Bulletin No. 67, Bureau of Explosives, is pointed in its lesson, as well as in its style:

"Because of a shortage of space, this one had to be left out of the preceding bulletin, but really, it is too good to miss. If your own ears burn when you read it, please note that no names have been mentioned, and gratefully accept the opportunity to turn over a new leaf.

"A freight train stopped somewhere along the line. In the train was an empty tank car which had previously contained gasoline. A couple of tramps came along, looking for free transportation to some region where handouts were freer and bulldogs more scarce. As a rule, a freight brakeman loves a tramp to about the same degree that a dog adores a cat; but in this particular instance the flag-bearer must have recognized a personal friend or something, for he cast about for a place wherein the brake-beam acrobats might ride without being detected.

"Aha! the empty tank car! Realizing that there might be vapors in the car even stronger than certain characteristics of the average tramp, the brakeman took the most dependable, as well as the most sudden, way of finding out. In other words, he lowered his lighted lantern through the dome!

"It really seems superfluous to go on. Our sentiments concerning the whole affair are most forcefully (though unintentionally) expressed by a paragraph from the B. E. Form 25, on which the case was reported. This paragraph is as follows, the numbers referring to numbered questions on the form:

"1—Blank! 2—Blank!

"3—Brakeman was inspecting interior of empty tank car to see if O. K. for trespassers to ride in it. As he lowered his lantern into the dome, gas explosion occurred, severely burning the brakeman and a trespasser about the head, neck, hands and arms. Brakeman will be incapacitated for a period of about three weeks.

"4—Blank. 5—Blank!

"The exclamation points are our own. The thought occurs that if the brakeman was burned about the head, possibly some charcoal was formed."

Safety first competition

By H. L. Needham
Master mechanic, Illinois Central, Clinton, Ill.

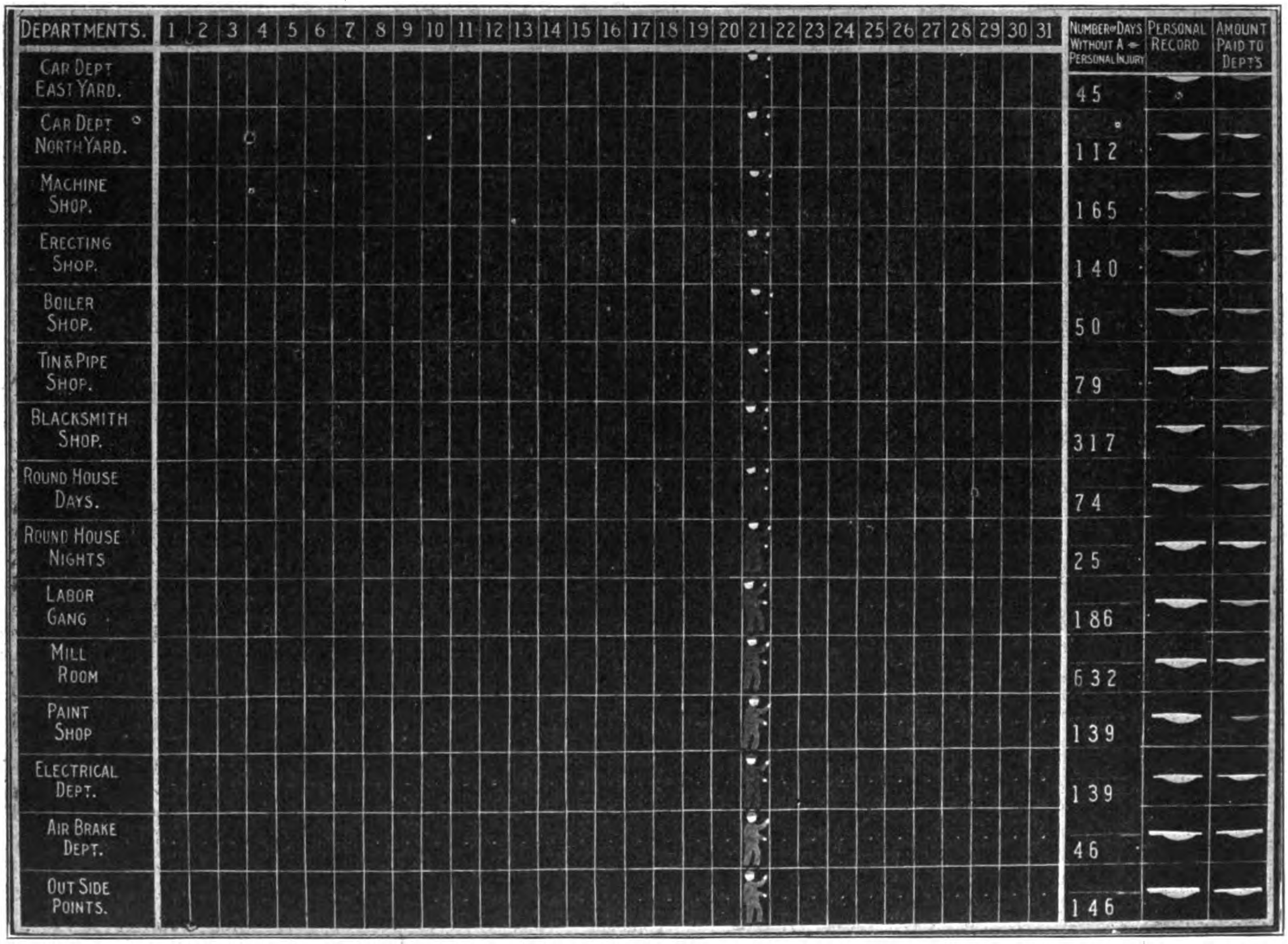
COMPETITION in safety first records is encouraged in the Clinton shops of the Illinois Central by means of the 63-in. by 90-in. board illustrated. At the top of the board the days of the month are indicated and at the left the various departments in the back shop, enginehouse and car repair yards. On the right of the board are three columns, one of which indicates the number of days which have elapsed without a personal injury and the other two containing pockets for personal record cards and cards indicating the amount of money paid to injured men.

About 700 shopmen are employed in 15 different departments, each of which is represented by the figure of a man which may be moved about on the board at will. Should a personal injury occur in one of the departments the figure is left standing at the date when the injury occurred, the name of the man being written on a small T-card and attached to the figure by a flap which slips in a pocket provided for this purpose. The figure remains on that date until the close of the month, an additional figure being started in its place. Should a second man be injured in that department the second figure is left on the date on which the injury occurred, and in this way at the end of a month there are as many figures on the board for each department as there have been accidents in the respective departments.

The use of this board keeps before the supervisory officers the names of the men who are injured, the department in which each works, the number of days which have elapsed without a personal injury, together with the amount paid in compensation. Healthy competition between the departments is stimulated.

The board illustrated was put in use May 1, 1925. During the month of May, 1924, 11 injuries were reported in the mechanical department at Clinton, there being none in May, 1925. In June, 1924, 11 injuries were again reported, there being two in June, 1925. A similar improvement was made in July. In other words, and four injuries during a similar period in 1925.

Much interest has been shown in the matter of safety since this arrangement for visualizing results was put into effect. Each department endeavors in every way to keep from having an accident which will spoil the record of "number of days without a personal injury." Moreover, the employees do not want their names to appear on this board and consequently do everything in their power to prevent getting injured.



Safety first board used at Illinois Central shops, Clinton, Ohio

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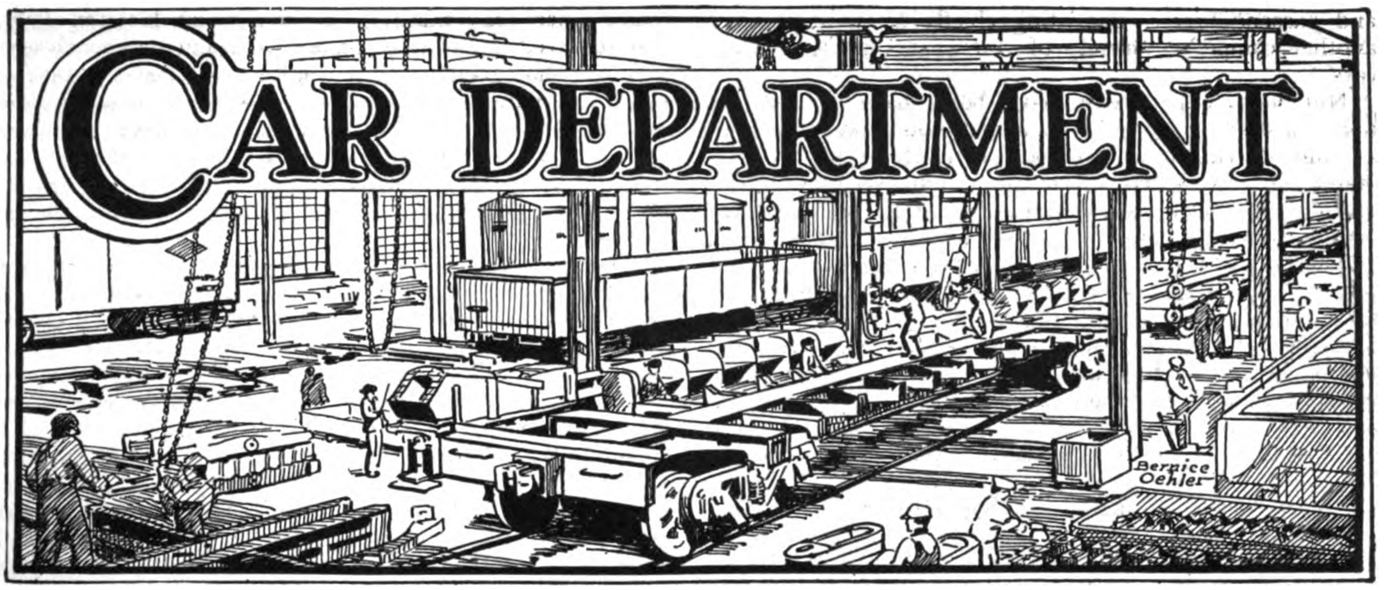
A SECOND WASTE RENOVATOR and oil reclaiming machine has been installed at its shops at River Rouge, Detroit, by the Detroit, Toledo & Ironton, and is reclaiming an average of 80 gal. of refined oil and 260 lb. of clean waste daily. The operation has been simplified to such an extent that the cost has been reduced considerably below the value of the oil and waste reclaimed.



Car inspectors and foremen hold twenty-fourth convention

Opening sessions featured by papers on lubrication and progressive freight car repairs

THE twenty-fourth annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America was held at the Hotel Sherman, Chicago, September 22, 23 and 24. The sessions were presided over by President C. M. Hitch, a total of 549 members and guests being registered in attendance at the convention. Short informal addresses were delivered by F. H. Hammill, executive vice-president of the Chicago, Rock Island & Pacific, and F. W. Brazier, assistant to the general superintendent of rolling stock, New York Central. Among the individual papers presented were Progressive System of Freight Car Repairs, by F. A. Starr, general car inspector of the Chesapeake & Ohio; Lubrication, by L. R. Christy, general car inspector of the Missouri Pacific; A. R. A. Billing and Preparation of Records, by L. Martin, chief accountant, A. R. A. Bureau, Baltimore & Ohio, and Prevention of Transfers and Transfer Claims, by F. S. Cheadle, chief car inspector, Richmond, Fredericksburg & Potomac. Abstracts of these addresses and the convention proceedings will be published in this and succeeding issues of the *Railway Mechanical Engineer*.

New officers elected

The following officers were elected for the ensuing year: President, W. P. Elliott, general foreman, Terminal Railroad Association of St. Louis, East St. Louis, Ill.; first vice-president, B. F. Jamison, special traveling auditor, Southern, Meridian, Miss.; second vice-president, E. R. Campbell, general car foreman, Minnesota Transfer, St. Paul, Minn.; third vice-president, M. E. Fitzgerald, general car inspector, Chicago & Eastern Illinois, Danville, Ill.; secretary and treasurer, A. S. Sternberg, master car builder, Belt Railway of Chicago, Chicago. The following were elected members of the executive committee to serve two-year terms: F. A. Starr, general car inspector, Chesapeake & Ohio, Covington, Ky.; L. R. Christy, general car inspector, Missouri Pacific, St. Louis, Mo.; and W. R. Rogers, chief interchange inspector, Youngstown, Ohio.

Lubrication

By L. R. Christy

General car inspector, Missouri Pacific, St. Louis, Mo.

The problem of bearing lubrication is the oldest of all lubricating questions. As we review its development since man first conceived the idea of vehicular movement with bearing surfaces, we find that innumerable improvements have been made in the designs of journals and bearings, the refining of lubricants and methods pursued to insure correct practice. It is obvious that the future will unfold further advantages over our existing standards of lubrication.

Selection of materials

In the purchase of waste, it is essential that the material be free from rags, knotted fibre, particles of metal, grit and other foreign substances, and that the strands be of sufficient lengths. To insure this, the waste should be bought on specifications sufficiently rigid to permit of rejection of material which does not meet these requirements. The waste must have properties that give the necessary degree of resiliency to insure proper contact with the journal at all times, and be capable of conveying the oil to the journal with sufficient rapidity to maintain the lubricating film without breakage. There seems to be a fairly unanimous agreement that the two standard types of waste are preferable: one for use on locomotives

and passenger cars, consisting chiefly of wool strands; another composed entirely of cotton strands for freight cars.

Numerous experiments have been made in order to obtain a bearing metal formula that would cause the least amount of friction, and yet be sufficiently strong to withstand pressure without crushing. Our standard lining metal is a tri-metal alloy, consisting of 85 per cent lead, 10 per cent antimony and 5 per cent tin. This closely follows the recognized standards of a great many of the principal railroads, and is a satisfactory formula. A lining metal of this kind, due to the greater proportion of lead in the formula, will, within a short time, conform to the contour of the journal and reduce the unit pressure to a minimum. In the purchase of new journal bearings, and where old journal bearings are relined by outside companies, it is advantageous to have the test departments of the railroads make periodical inspections at such plants to determine whether proper compositions are used.

We can ill afford to discuss the subject of lubrication without considering the laws of friction, as it is apparent that, were there no friction, there would be no necessity for interposing a lubricant between the journal and journal bearing. The primary object of bearing lubrication is to provide a lubricating film between the rubbing surfaces, and thereby replace the metallic friction with fluid friction, so far as possible, and then, to minimize the fluid friction in the oil itself. Fluid friction is independent of the pressure of the surfaces in contact, but is directly proportional to the area of the rubbing surfaces. If we will give but a moment's thought to this statement, we will realize that it is true, because, each infinitesimal particle of oil will retard the movement of the entire body of oil, and, as the viscosity of the oil increases, so will the fluid friction. Compare the flow of oil from a receptacle, first using a light car oil and then a heavy valve oil. The light car oil will flow from the receptacle more readily because its fluid friction is lower than that of the valve oil. It must be remembered, however, that, as the temperature of the bearing increases, the viscosity of the oil decreases, and the body of the oil must be such that it will maintain the film without breakage at the normal running temperature of the journal. Experiments conducted to determine the relative temperature of the journal, the bearing and the lubricant have indicated that the temperature of the lubricating film is higher than that of either the journal or the bearing. It therefore follows that the least viscous lubricant not unduly influenced by great variations in temperature is the most desirable car oil. The oils which best satisfy these requirements are mixtures of mineral oil and suitable fixed oils.

Renovation and saturation of packing

The company with which I am connected, arranged during the current year for the installation of waste renovating plants of modern design at two of its principal shops. All journal packing removed from locomotives, passenger cars and freight cars, in addition to waste used in shops, is forwarded to these plants for renovation. The journal packing thus reclaimed is also re-impregnated at these plants, as is the saturation of new packing, and this material completely prepared for immediate use, is apportioned to the various shops, repair and inspection points, as needed. It seems to the writer to be of sufficient interest and probably value to relate the process as it obtains and the results achieved in this manner.

The packing removed from journal boxes, and the discarded waste in shops is placed in specially constructed metal containers, of approximately 300 lb. capacity, and bearing necessary markings to distinguish between packing removed from locomotives, passenger cars, freight cars and shop waste. As promptly as sufficient quantities are accumulated at any point, shipment is made to the nearest renovating plant. These same containers are used, of course, in forwarding packing to the various locations, and in this manner sufficient containers are always available at both the plants and the outlying points on the railroad.

When consignments are received at the plant, the contents of each container are weighed, inasmuch as a complete record is kept of the material received and issued to each point, which affords a positive method of determining whether or not all old material is returned.

The waste is first placed in metal trays, where the larger pieces of babbitt, cinders, small stones and other similar foreign substance are removed. This requires only a few minutes to each container of packing. The next operation consists of placing the waste in a heating tank, where it remains approximately 20 min. immersed in oil, at a temperature of 130 to 140 deg. F. It is then forked up on a drain board and drained for a period of from three to five minutes. Then, the waste is removed to a motor driven centrifugal extractor, which is equipped with a filtering arrangement, and rotated for five minutes at the rate of approximately 1,200 r.p.m. At this stage of the process most of the oil has been removed, filtered and drained into an underground storage tank. After this operation, the waste is conveyed to a motor driven cleaning and drying machine, where the dirt is thoroughly removed from the material, and it is dried within 12 min. This machine is equipped with steam coils and air intake fan and operates under air blast at a temperature of 180 deg. F. The cylindrical container oscillates after making two and one-half revolutions in either direction. When the waste is removed from this machine, it has been thoroughly renovated and is ready for saturation in the waste impregnator. This device, by the combined use of a vacuum pump and compression head, actually accomplishes the complete saturation of the waste in less than five min. In preparing packing from the renovated waste, only the reclaimed, filtered oil is used, which is pumped from the underground storage tank to the impregnator. Past experience has shown that one gallon of surplus oil accrues to each 100 lb. of waste renovated. In other words, slightly more oil is recovered from this amount of renovated waste than is consumed when it is again saturated. It has been demonstrated that oil does not wear out in service, but simply becomes contaminated with foreign matter, and after proper reclamation is, in reality, as good as new oil. New oil is used with new waste in preparing new packing. In no case is new packing mixed with renovated packing.

An electrically operated machine for making packing rolls is also contained in this system.

The capacity of each plant is two and one-half million pounds of renovated packing per annum, which reduced to an average daily production, amounts to 9,000 lb. The services of five men are required in connection with the operation of each plant.

This system has many varied advantages over the ordinary methods of reclaiming and saturating packing. You have perceived that the entire operation of renovating and saturating the packing requires less than one hour, as compared with 48 hours, which is the usual length of time waste is subjected to immersion, not to mention the labor incident to cleaning waste by hand. Without doubt, the packing is decidedly cleaner and the oil penetration is better. By concentrating this work into fewer plants of greater capacity, and modern design, a large number of small obsolescent plants were abandoned.

Aside from the improved mechanical features mentioned, this concentration alone insures both economy and uniformity of practice. With both, a substantial saving is possible, owing to the greater percentage of oil and waste reclaimed, including the used shop waste converted into freight car packing, and a corresponding decrease in new oil and waste issued. Moreover, the extravagant use of materials is minimized, if not entirely eliminated, by this procedure. Wasteful practices are more difficult to correct where the packing is prepared at numerous points, as it is evident packing indiscriminately made is not always properly drained, nor is all old packing accounted for, as it is often left in train yards, thrown in outbound cars, used in firing locomotives, or otherwise discarded, unless there is some definite means to keep a record of the consumption. This process also largely precludes the use of free oil which is such an expensive factor in lubrication.

Considerable discussion has ensued at these meetings with respect to conditions contributing to hot boxes, as well as the proper method of packing boxes. It follows that the causes are generally understood, and doubtless there is but a slight divergence of opinion concerning the packing of boxes, which is largely restricted to the advisability of applying a filler, or plug, at the front of the journal box. Reasoning on this basis, it is apparent we should then determine whether the correct practices are followed. Have we assured ourselves that inspection forces are sufficiently alert in their efforts to discern the various defects that result in hot boxes? Are we certain that oiling forces in train yards are giving necessary service treatment to cars, and that sufficient dexterity is shown with the packing iron?

Considering the importance of the proper use of the packing iron, it is surprising how frequently this attention is neglected. I am inclined to believe that few railroads have standard packing irons and packing hooks, as is evidenced by the miscellaneous assortment in use. Many of these are of such dimensions and construction as to prevent oilers from obtaining best results. A satisfactory means of fixing individual responsibility for improperly packed boxes, is to assign to each oiler a symbol number, with alphabetical prefix to designate terminal or division, and require him to mark this symbol on both sides of car when he has given service treatment, or repacked boxes. If trouble subsequently develops at any point on the railroad, due to improper attention, it is possible definitely to place responsibility with the oiler at fault.

It is conceded that cars ordinarily do not remain in train yards for a period sufficient to make a thorough inspection of packing in all boxes, and to completely adjust packing, or repack boxes when necessary. In view of this condition, it behooves us to give thorough attention to cars when on repair tracks where facilities are available. In such instances, the packing should be entirely removed and each box repacked at designated intervals. The necessity of complying with this practice cannot be too forcibly emphasized, and if each railroad will actively pursue a program of this kind, an appreciable reduction in the number of hot boxes will be made. During the time the car is on the repair tracks, reasonable precautionary measures should be taken with respect to the mechanical conditions that contribute to hot boxes. Trucks should be in proper alinement; journal boxes parallel and not unduly worn; tops of boxes free from irregular surfaces, dirt and grit; broken or missing truck springs should be replaced; wedges should not be distorted or otherwise defective. When wheels are exchanged, compound should be thoroughly removed from journals and journal boxes carefully cleaned. Due care should also be exercised in removing worn truck pedestals on passenger cars. The best results are not obtainable when relined journal bearings are used on passenger cars. The periodical jacking of boxes on passenger cars, for the purposes of carefully examining journal bearings, wedges and journals, is advisable and necessary to the successful operation of passenger trains. Our practice is to inspect each passenger car in this manner at three months' intervals. The expense thus incurred is promptly offset by the reduction in cost of caring for hot boxes.

Before concluding, I desire to comment briefly on the intimate relation of supervision to the suppression of hot boxes. Intensive supervision is always a potent factor in this respect, just as it is in connection with various other phases of our work. A single illustration of its significance is that hot box trouble does not long remain in epidemic form at any one point.

C. M. Hitch (B. & O.)
President

W. P. Elliott (Terminal R. R. Assn.)
1st vice-president

B. F. Jamison (Southern)
2nd vice-president

A. S. Sternberg (Belt Ry. Chicago)
Secretary

Progressive system of freight car repairs

By F. A. Starr

General car inspector, Chesapeake & Ohio, Covington, Ky.

The repairs to freight cars may be divided into two general classes or grades: light and running repairs, which is that class of repairs accruing from current wear and breakages; and classified heavy, general and rebuilt repairs, which is that class of repairs involving the restora-

tion of the car as a whole to first class condition for a period of time.

Scheduling and routing

Many forms of scheduling and routing systems have been developed and successfully installed in locomotive and passenger car repair shops, but only in the last few years has any degree of perfection been reached in the scheduling of freight cars. Fundamentally, such systems are very similar in principle and application to freight cars, and there is no reason for assuming that a system, which has greatly benefited locomotive and passenger car repair shops, will not produce equally satisfactory results in freight car repair shops. The quantity of freight cars repaired automatically induces systematic operating methods; but the scheduling and routing of freight cars is more difficult on account of the large number and many types of cars, and the extensive area over which they operate as compared with either locomotives or passenger cars, which operate over one or two divisions while freight cars operate over the entire road and country. The most successful freight car scheduling is obviously dependent upon large operation and number of cars in the same series, sufficient material and supplies, and a complete organization which will enable men to be highly classified into special gangs. It is not really difficult to handle up-to-date scheduling and routing methods in freight car repair shops, but it may be necessary completely to rearrange or relocate repair tracks, material storage, and associated shop facilities.

Advantages and possibilities of progressive system

It has been conclusively demonstrated that with the progressive system of shop operation there are greater possibilities for economy and efficiency than with any other method yet devised. This system permits of properly organizing the shop forces, systematic delivery of materials at designated points and at defined intervals. It is conducive to specialization of the work by groups and individuals, which is an important factor in production. It lessens the multiplicity of tools and fixed equipment, also simplifies supervision as the men become familiar and more efficient in the execution of the particular operation for which they are responsible, and are induced to devise plans and means, and to provide themselves with suitable tools especially adapted to their portion of the work, which greatly contributes to increasing and improving output and reducing labor costs. The men become better satisfied and more interested in their work, co-operating closer with the supervisor; friendly rivalry or competition arises among the various gangs, striving not only to increase quantity but to improve the quality of work as well. All of these advantages and conditions greatly reduce the probability of personal injury to the workmen.

The only objection raised to the adoption of this system is the effort necessary to collect cars in the same series at the same shop in sufficient number to make the operation a success, and the possibility that work on another series of cars might retard the progress. However, it is possible, except perhaps on smaller roads, to overcome this difficulty by arranging a schedule of classified repairs to freight cars to extend over a period of from two to ten years, and cars in certain series can be shipped to the shop to which that series is allotted from other shop points. The advisability and practicability of shopping cars by series or classes is recognized, and most of the obstacles in this respect have been overcome to the extent that the method has become quite general in its application to heavy and classified freight car repairs.

On roads large enough to so arrange, cars in the same series may be allotted to two or more shops to eliminate all possible empty car haul.

Materials

One of the most important requirements of this system is the prompt delivery of materials, which should be done by tractors or electric driven trucks with trailers, unless the shop is equipped with overhead cranes. No work should be started on the repair schedule until material necessary to complete the program is on hand in sufficient quantities to carry on the work until the remainder required is received, that there may be no hold-up or retarding of the progress on account of shortage of material.

Suggestions for repairs

In the actual work of repairs it is suggested that draft gears, attachments, and center sill construction be sufficiently strengthened, so that the shocks incident to modern service will be absorbed and distributed throughout the car without causing excessive damage to the superstructure. Center sills and draft sills should have sufficient sectional area and should be protected against buckling by the use of cover plates. A common cause of failure in steel cars is due to the bodies of hopper cars not being securely fastened to the center sills. A few rivets are driven in the hopper sheets to hold the body to the center sills, and the heads corrode or wear off, allowing the rivets to pull through the sheets. This results in the whole strain being thrown on the body bolsters, which are usually of a wide single plate type, with result that they are unable to stand up under the strain. The sills start moving back and forth under the car which soon gets in such condition that permanent or thorough repairs become a rather expensive operation. These conditions must be overcome as far as possible when car receives heavy repairs, if it is expected to continue the car in service. The sides and ends of steel equipment should be properly reinforced to prevent bulging or buckling. Doors, and door equipment and appliances should be kept in proper working order to facilitate unloading. Care should be taken in repairing trucks of all cars to provide proper side bearing clearance, and to see that air brakes and running gears are kept in good condition.

A well defined program of reinforcement should be outlined and put into practice on all roads. The cost of such additions and betterments is usually insignificant when the future life and productive service of the car is considered. Money appropriated for such features is a good, sound investment, when judiciously used, and should pay large dividends. Many roads make the mistake of repairing their older equipment in kind as they do not have exacting conditions on their line. Such equipment should either be reinforced or kept on their own line and not offered in interchange, when there is a possibility of it getting out into the large industrial centers and into heavy tonnage trains, when it is almost an impossibility to keep it off the repair tracks. This places an unnecessary burden of expense on both the owner and the handling line.

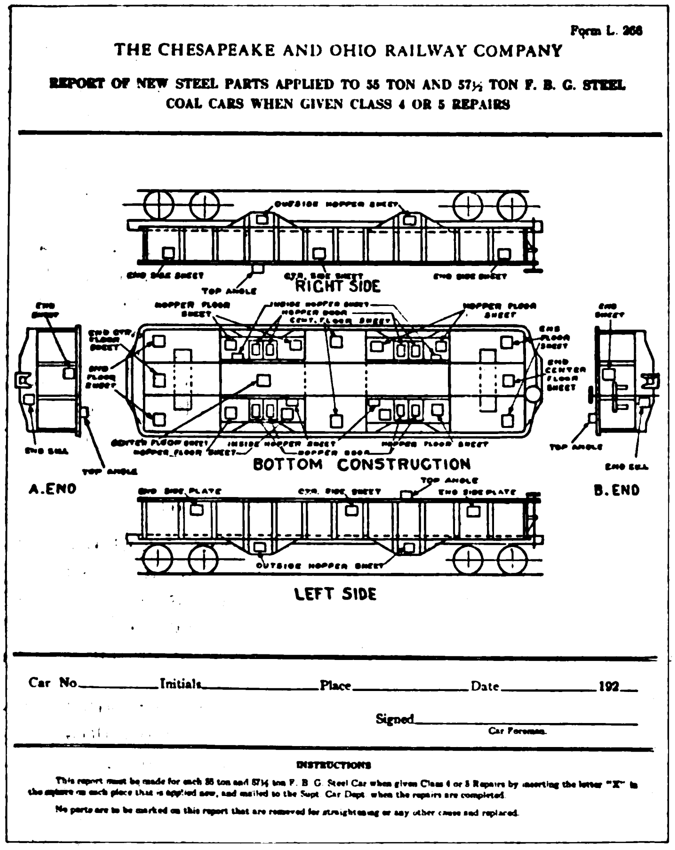
As cars come into the shop for general repairs, a careful inspection should be made; and, if a car has not deteriorated to the extent that it is felt advisable to scrap it, it should be repaired in accordance with a well defined reinforcement program, as outlined. Otherwise, if this is not done, after considerable money has been spent on the car it will again come back to the shop track.

Manner of handling work

A meeting of general, district and divisional car department officers is called three or four months before the close of the year, and the shopping schedule thoroughly dis-

cussed. A chart, previously prepared, showing the cars due for classified repairs or to be rebuilt the following year, is carefully considered and the cars are allotted to each shop represented, commensurate with its force and facilities. All cars in the same series are rarely allotted to one shop, but to at least two shops on opposite ends of the road. The cars to be rebuilt are selected by their general condition, the age being an important factor in determining just what parts of the cars are due for renewal. Past experience, tests, and service conditions and requirements under which steel car equipment operates, have demonstrated that floor and hopper sheets should be renewed every 10 or 12 years, while the side and end sheets will run for approximately 16 years before requiring renewal, if 1/4-in. thick. A definite program of reinforcement is outlined and closely followed.

At least 90 days is allowed in advance of starting on the


Form L. 268

THE CHESAPEAKE AND OHIO RAILWAY COMPANY

REPORT OF NEW STEEL PARTS APPLIED TO 55 TON AND 57½ TON F. B. G. STEEL COAL CARS WHEN GIVEN CLASS 4 OR 5 REPAIRS

Car No._______ Initials_______ Place_______ Date_______ 192__

Signed__________
Car Foreman.

INSTRUCTIONS

This report must be made for each 55 ton and 57½ ton F. B. G. Steel Car when given Class 4 or 5 Repairs by inserting the letter "X" in the square on each piece that is applied new, and mailed to the Supt. Car Dept. when the repairs are completed.

No parts are to be marked on this report that are removed for straightening or any other cause and replaced.

Form on which a record is kept of the new steel parts applied to each car

repair program to enable the purchasing and stores departments to purchase and deliver materials required; so, immediately following the allotment of cars to be rebuilt, each shop participating in the repair schedule places a requisition for 50 per cent of the material it will require, which should place this material on the ground in time to start with the year's program promptly. The other 50 per cent of the material is requisitioned in sufficient time so that it will be delivered in time to prevent any cessation of the work. If more than one series of cars are allotted to one shop, which is sometimes necessary, it is determined at the general meeting the order in which each series is to be routed through the shop and the material is ordered accordingly, the same advance information and consideration being given the stores department as mentioned above.

The entire schedule is laid down on a schedule and performance sheet, which permits the recording of starting and completion dates in proper sequence. The closest co-operation between the car and stores departments is absolutely necessary, not only to prevent any shortage of materials but also to avoid any surplus material being left on hand when the program is finished.

Classified repairs of steel cars

Cars in the same series are placed on bonded tracks equipped with electric rivet burning apparatus consisting of the following:

A generator supplying direct current not to exceed 80 volts, with 450 to 500 amperes for each cutting unit employed, located as near to cutting tracks as possible to prevent voltage drop.

Lead wires from generator to cutting stations of sufficient area to prevent excessive loss of watts.

A permanent scaffold six feet high and two feet wide, extending the entire length, and on both sides, of the burning tracks, the frame work of which is used for carrying the supply wires and having plug-in switches every 40 feet.

A rivet burning tool consisting of a graphite stick, held by a handle, of sufficient area to prevent excessive temperature resulting from heavy amperes carried.

A specially constructed mask to protect the operator's eyes and face from violet ray.

Cars placed on bonded tracks are inspected by a competent inspector or gang foreman. All sheets to be removed and replaced with new are marked with yellow crayon. All sheets and other parts to be removed, repaired and replaced are market with red crayon. All rivets not in sheets and other parts marked for removal, but necessary to be burned from draft lugs, center braces, door fastenings, etc., are also marked by the inspector.

Marked rivets, and rivets in sheets and other parts to be removed, are burned by placing the electric torch on the head or button of the rivet, depressing the head without injury to the sheets, stakes, or other parts that are to remain in the car. One operator burns out an average of 1,500 rivets each eight hours, and same operator cuts scrap sheets in shape for loading out as scrap; classification "Steel cars cut for shears." This operator is followed by an operator with a nine-inch pneumatic hammer, who backs out an average of 1,800 rivets each eight hours.

The major portion of the work done by electric burning and back-out rivet gangs is done on the second and third shifts, one burner and one back-out man forming a unit; but this operation can be extended over the three shifts or all be done on the first shift, depending on the track space and output desired.

When rivets are backed out the sheets are dropped, and the following day all scrap is picked up by a locomotive crane, equipped with a magnet, and loaded directly into cars to apply on a scrap sales order previously secured by the purchasing department. This eliminates unnecessary handling and the necessity of providing storage space to accumulate this class of scrap while awaiting sale. Parts to be repaired and replaced are pooled at the straightening shop, which is equipped with a furnace, a face plate, presses and necessary tools to restore parts to original shape. Nothing then remains but the skeleton car which is moved to the heavy repair tracks and the work proceeds from there as follows:

The second operation is performed by gang No. 2, or the truck gang. The cars are jacked up and placed on tripods, the trucks dismantled, and all broken or defective parts removed. This gang repairs all trucks and lets cars down on the trucks at the proper stage in the progress of the schedule. All arch bars are removed and taken to the smith shop where they are annealed and reset, by which process any crack or fracture is easily detected.

The dismantling gang, or gang No. 3, follows and backs out all rivits that cannot be taken out on the burner track, drops all couplers, draft gears, cylinders, reservoirs, bolster tie plates, space blocks, center plates, draft castings, and any other parts to be removed from the car.

Following the dismantling gang, the straightening gang, No. 4, straightens all parts that are to remain in the car, and prepares the car for the fitters.

The first fitters, or gang No. 5, follow and fit up all underframe work, end sills, tie plates, splice plates, space blocks, corner posts, sub-side sills, center plates, etc. Gang No. 6, the first reaming gang, reams the underframe, end sills, and all work fitted up by the first fitters, and makes the car ready for the first riveters.

The first riveters, gang No. 7, follow and drive all rivets under the car body and all rivets that must be driven before the car is fitted with side or floor sheets.

When entire sides are renewed, the side sheets, stakes, top and bottom angles are riveted up on the bench in jigs by gang No. 8, or the bench gang, and hung complete with locomotive crane by the 9th or second fitting gang. Gang No. 9, or the second fitters, working with an electric crane truck or locomotive crane, fit up the body of the car, hanging with special fitting up bolts, sides complete, side and end sheets or floor, hopper and cross ridge sheets, side and end posts; top and bottom, side and end rails, tie braces, side knee braces, etc. Gang No. 10, or the second reamers, follow and ream the entire body and prepare for the body riveting gang.

Gang No. 11, the second or body riveters, then drive all rivets in the body of the car, grab irons, sill steps, brake shaft platform and brackets, door attachments, etc. One gang fits up all door locks ready for final or OK riveters.

Gang No. 12, or the coupler gang, works in at any time after the bottom of the car has been driven. This gang puts up all couplers, uncoupling levers, card boards, brake mast, brake rods, brake levers, center pins, lock doors, greases center plates and side bearings, lets the car down on trucks, gages couplers and adjusts side bearing clearance.

Gang No. 13, OK riveters, works in one gang, driving all rivets in door locks, front carrier irons, and any rivets overlooked by regular riveters or missed by reaming gang, and drives all rivets marked out by the inspector. This method insures that all the work is properly performed.

Acetylene burners work in one or two gangs of one car repairer and one helper each, cutting out any rivets necessary to leave in on the burning track, cutting out bolster web plates for center sill splice plates, and any other work necessary to keep the regular gangs moving.

Laborers and helpers form a material delivery gang and work as follows: One man operates each electric truck engaged in the distribution and delivery of material, and, with two or more men, delivers to the car and truck all sheets, posts, rails, truck frames, wheels, spring planks, bolsters, and any other heavy materials. They also handle all couplers, arch bars, truck side frames, and other material, to and from the smith shop. One man keeps the rivet heating furnaces in repair and looks after the oil supply for rivet furnaces and heating torches. One or two men deliver to the cars and trucks all light materials such as grab irons, card board, brake mast and platform, ratchet wheels, brake hangers, brake levers, brake hanger rods, bottom connections, journal boxes, lids, brass and wedges, and bolts, nuts and rivets in quantities.

Located convenient to shop tracks are sufficient material racks with bins in which are kept short bolts, nuts, washers, cotters, clevises, knuckle pins and locks, brake pins, nut locks and grip nuts, and other small materials which are used in small quantities. One man takes care of these racks, replenishing the stock daily, and he also picks up any usable material left on the ground by carmen, returning it to the proper bin in the nearest rack. A standard list of material to be carried in each rack is posted, and each forenoon the attendant makes a check of the material on hand in these racks, and any shortage is ordered at one time and replaced in proper bins. This keeps a stock of such material on hand and convenient for the carmen's use at all times, thus eliminating the probability of waiting for the delivery gang or of hunting up the foreman for an order to the store room.

When cars are ready to paint they are moved to the shipping track where the air brake men, two car repairers and one apprentice repair and put in first class condition train lines, brake cylinders, and reservoirs; applying triple, release and retainer valves, angle and cut out cocks, hose and dirt collectors, which are cleaned and repaired in accordance with A.R.A. Rules governing the Maintenance of Brake, Train and Air Signal Equipment; connect, test and adjust brakes. Train lines, hose and all connections are given soap suds test; brake cylinders are given leakage test by gage; and triple valves are cleaned, repaired and tested on a standard test rack.

The cars are painted on the shipping track with a paint spray, working from a push car running on the service track along side of the car. On this push car are carried all supplies and materials required to coat the setting. When the paint is dry the stencilling is done from a scaffold erected on a push car, on which all supplies and stencils, made in panels, are carried. The painter moves himself on this push car by taking hold of the side of the car and pulling the scaffold and push car with him to the desired location.

Final inspection is made of cars on the shipping track, and any work marked out by inspector is corrected, if possible, before the painter has left the car. Cars are then reported ready to be pulled and weighed.

An individual car record of sheets removed is kept on special forms, as shown in the illustration. These forms are filed numerically and the record is available at all times in the general office to determine the general condition of an individual car of the series.

Classified repairs to box cars

After cars in the same series are spotted and properly spaced, they are carefully inspected by the gang foreman, accompanied by the stock clerk, and all parts to be renewed or repaired are so marked, and check made of material available, and necessary action taken to have all material on the ground when required.

Gang No. 1, or the truck gang, jacks up all cars in the setting, runs out the trucks and lets the cars down on trestles or tripods in a safe manner, after which it dismantles the truck, removing all defective or broken parts. All arch bars are removed and taken to the smith shop where they are annealed and reset. This gang is so regulated that trucks are rebuilt when the car is ready to let down.

Following the truck gang, the stripping gang, or gang No. 2, consisting of two car repairers and sufficient laborers to keep the yard clean of scrap lumber, removes all trimmings, drop couplers and draft gears, defective or broken siding, flooring, lining and roofing.

The sill and frame gang, gang No. 3, follows and removes all defective or broken sills, posts, braces, side plates and end plates, belt rails, purlines, ridge poles and carlines, replacing them with new, squaring the car, tightening all sill and plate rods, trussing car, repairing and replacing couplers and draft gear, and letting car down on truck. This gang also removes, repairs and replaces body bolsters and draft arms.

The fourth operation is performed by the sliding gang, which applies all siding, side and end fascia, door tracks and top corner bands. The roofing gang, gang No. 5, follows and patches or applies roofs complete with running boards. The flooring gang, gang No. 6, patches or applies new floor complete. This gang is followed by gang No. 7.

the inside or lining gang, applying or patching all end and side lining and grain strips.

Gang No. 8, or the safety appliance gang, follows and applies all grab irons, sill steps, lift levers, center corner bands, brake shafts, front and back door stops, and hangs the doors. The doors are repaired or made new and trimmed in the door shop and delivered to the car ready to hang.

The steel gang, gang No. 9, consisting of two or more car repairers and apprentices, is what may be termed a floating gang, doing any steel work required, such as straightening riveting, etc., and works closely in touch with the sill and frame gang. The acetylene gang, consisting of one car repairer and one apprentice, works wherever needed and has no regular routing to follow.

The air brake men are the last to finish their work of repairing and putting up train lines, brake cylinders, reservoirs and triple valves, and connecting, testing and adjusting brakes. Triple valves are repaired, cleaned and tested on a standard test rack.

Where the shipping track is provided the cars are pulled from the shop track and spotted on the shipping track, where painters and air brake men perform their portion of the work, similar to the same operation on cars of steel construction.

The painters follow closely behind all wood working gangs, painting sills, belt rails and plates ahead of siding, roofing and flooring gang, whom they follow closely. Cars are all painted and stencilled when the air brakes are tested. After a final inspection the cars are ready to pull. The yardmaster is so notified; and a list is furnished him of the cars to be set in after OK'd cars are pulled from the tracks.

The working of cars in the same series is an advantage to all departments. The siding, roofing, flooring and lining is cut to length in the mill. The same material, bolts, castings and timber are used throughout the entire setting. The painter need carry only one set of stencils for the series of cars being repaired.

The number of men in the various gangs, on both steel and wood cars, is governed by the amount of room on shop tracks, facilities, the output desired, the class of equipment undergoing repairs, and the amount and character of repairs, reinforcements, etc., necessary and applicable to the majority of the cars in the setting.

Requirements

What is needed more than anything else is a systematic program for making heavy repairs to freight cars so that a certain percentage of the equipment will be given such repairs each year, this percentage to be based on the number of years a car can safely run between heavy repairs. Locomotives are shopped on a mileage basis. Why not establish a reasonable and scientific basis upon which to shop freight cars and then see that it is lived up to. This will keep the equipment in prime condition, at a minimum of expense, after a systematic program has been well established.

Shops should be provided at points where heavy repair car work is performed. Overhead crane service is desirable and by proper arrangement eliminates the necessity for material or service trucks between the working tracks. Small wall of jib cranes should be installed for handling yoke riveters, etc. The money expended for shops will repay the investment many times over in a few years.

There is a large field for consideration and planning, when designing new shops, to provide proper tracks and facilities, which will co-ordinate with production systems and schedules best adapted to produce maximum output and minimum cost.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Another case under Rule 32

C., M. & St. P. car No. 9403 received some damage while in possession of the N. Y. C. & St. Louis which it was claimed occurred in the ordinary switching service and disposition was requested from the owners in accordance with Rule 120. The car owner claimed that the damage was due to the handling line responsibility. In making its contentions, the car owner stated that it had received a letter from the handling line which stated, among other things, that it was not the practice to ride cars in Conneaut Yards where the accident occurred. The car owner further contended that the damage exceeded that specified in the footnote to Rule 43. The handling line contended in its statement that it had received the car in question from the N. Y. C. at Buffalo, N. Y., at which time an inspection was made which revealed a number of defects. In view of these defects the car was billed home to the owner at Chicago. It was while the car was en route home that it was damaged in switching service which caused eight sills to break on the car. As the car was not derailed, roughly handled or damaged in any other manner outlined in Rule 32, the handling line felt justified in requesting a settlement in accordance with Rule 120.

The Arbitration Committee rendered the following decision "The car being handled without rider protection, the handling line is responsible as per Rule 32, Section D, Item 4. See Arbitration Decisions Nos. 1224 and 1331.

"In the event repairs are made, the car owner is responsible for that portion of the defects which are ordinarily the owner's responsibility and not associated with the delivering line defects, as provided in Rule 41."—*Case No. 1335, Chicago, Milwaukee & St. Paul vs. New York, Chicago & St. Louis.*

Wheels remounted on Standard A. R. A. axles with wheel seats in excess of standard diameter

The Chicago, Burlington & Quincy included in its bill to the Southern Pacific a charge amounting to $36.06 for repairs to S. P. car No. 62342 at Alliance, Nebr., November 30, 1921. The bill in question bore no date, but represented the account as of November, 1922, and contained charges for repairs made on November 30, 1922. The car owner contended that revisions of Paragraph 2, Section A, Interchange Rule No. 91 of the 1921 Code, had been violated. The C., B. & Q. also included in this bill a charge for wheels and an axle changed under S. P. car No. 24846 at Alliance, November 17, 1922, on account of one wheel being tread worn and the other having a large bore, at the same time scrapping the axle on account of large wheel seats. The car owner contended that the axle should have been credited at second-hand value. In defense of the first part of the agreed

statement of facts, the S. P. contended that the second paragraph of Section A, Rule 91, distinctly provides a time limit of one year within which charges for repairs are to be represented. With respect to car No. 24846, the S. P. contended that the wheel and axle record represented by the repairing line shows the diameter of the wheel seats for the axle removed to be 7⅛ in. This was ⅛ in. larger than the dimensions for the new axle as specified in the table in Rule 86. However, its interpretation of this table was that the diameters for the wheel seats and center are minimum, and that there should be no objection to slight variations which in themselves actually increase the strength of the axle. The C., B. & Q. contended in its statement that it had complied with both the letter and spirit of Rule 91 and that the bill was actually made and rendered in November, 1922, with the necessary delay required to add final entries and make recapitulations along with 500 other bills for the same month. With reference to the renewal of the wheel and axle under car No. 24846, the handling line claimed that an axle for the minimum limit of wheel seat prescribed by the table in Rule 86 is in effect scrap and that wheels fitted to such an axle are likewise scrap regardless of whether the wheel seat dimension is great or small.

The Arbitration Committee rendered the following decision "With reference to the time limit for rendering a bill, Arbitration Decision No. 1228 is parallel. The contention of the C., B. & Q. is sustained.

"The general situation is such as to warrant the practice of using A.R.A. standard axles with wheel seats not more than ⅛ in. in excess of standard diameter for remounting second-hand wheels, in order to avoid scrapping good wheels. The 1924 Code of Rules will be modified to make this clear. Therefore, the contention of the C., B. & Q. is not sustained."—*Case No.* 1333, *Southern Pacific vs. Chicago, Burlington & Quincy.*

Credit for wheels removed because loose on the axle

On March 11, 1922, the Atlanta, Birmingham & Atlantic exchanged wheels under Illinois Central car No. 131255 showing under the "Why Made" column one wheel OK, one wheel loose on the axle and scrap on which a charge was made against the car owner for one pair of second-hand wheels applied, less one second-hand and one scrap wheel removed, or $3.60, it being claimed by the repairing line that the wheel scrapped was unfit for further use owing to having been removed from a standard axle. The I. C. maintained that both wheels removed should have been considered under the existing condemning limits as second-hand inasmuch as the A.R.A. rules make no provision for the scrapping of wheels for such causes as claimed by the repairing line.

In rendering its decision, the Arbitration Committee stated that "If the loose wheel was unfit for remounting on a standard axle with a wheel seat not more than ⅛ in. in excess of the standard diameter, it should be credited as scrap. If it could be so remounted, it should be credited as second-hand.—*Case No.* 1334, *Illinois Central vs. Atlanta, Birmingham & Atlantic.*

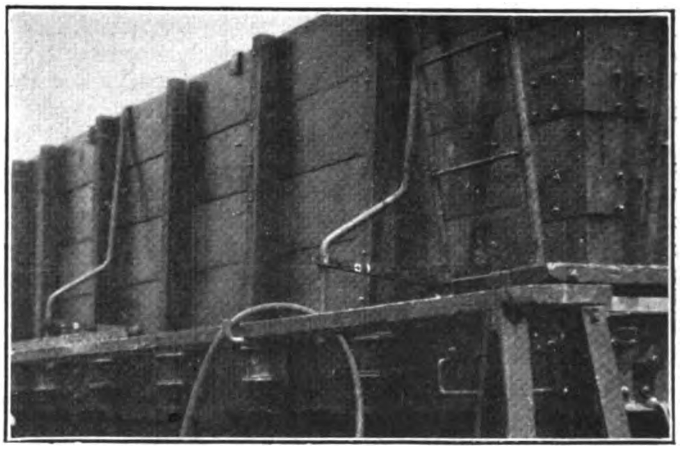
Car without rider protection damaged in switching service

On June 20, 1923, Canadian National car No. 610862 was damaged while being switched at South Chicago and was reported by the Chicago, Rock Island & Pacific showing an estimated cost for labor of $185 and material of $200, making the total $385. The damage occurred when two cars of coal, without rider protection, ran into C. N. car No. 610862, breaking it in two at the middle. The handling line contended that the responsibility for the damage to the car did not come under Rule 32, Section D, Item 4, nor the footnote to Rule No. 43 for two reasons: first, that only five sills were broken new which was evidenced by the records which show that when the car returned through interchange to the handling line, one side sill and two intermediate sills were broken, were old or decayed and were broken prior to the time the car was broken in two in switching service. Second, the car was not derailed, cornered or sideswiped. The handling line further claimed that rider protection was not necessary as the accident occurred in a level yard while the cars were being switched at ordinary safe speed. It was the contention of the car owner that the handling line was responsible under Rule 32, Section D, Item 4, and that the car should be handled under Rule 112, as no rider protection was provided.

The Arbitration Committee in rendering its decision stated that "The damage exceeded that shown in the footnote to Rule 43 and as car was being handled without rider protection, the handling line is responsible as per Rule 32, Section D, Item 4."—*Case No.* 1336, *Chicago, Rock Island & Pacific vs. Canadian National.*

A convenient type of portable scaffolding

An interesting feature of the car building contest recently held by the car department of the Delaware & Hudson at Carbondale, Pa., was the numerous kinks and unique practices used by the three contesting teams. The Oneonta team, the victors in the contest, were



Scaffolding arrangement used by the Oneonta team, victors in the D. & H. car repair contest

especially well equipped with various improved tools and devices for efficiently performing the work. One of these devices is the portable scaffolding shown in the illustration.

The planks for the floor of the scaffolding are placed on a bracket made of round bar iron about 1¼ in. in diameter. The bar is bent so as to hook over the side of the car and extend down to form a support for the plank, as shown in the illustration. It is held in position against the side of the car by means of a brace made of ⅜ in. by 1¼ in. wrought steel bar. The brace is made in two pieces, bent to the same shape, so as to form a clamp for the round bar at one end and a base at the other. The two pieces are then placed back to back, clamping the round bar as shown in the illustration, and held securely by three ½-in. bolts.

Master Painters meet at St. Paul

Methods of securing satisfactory painting results with the least expenditure of time and money are discussed

THE fourth annual meeting of the Equipment Painting Section of the Mechanical Division, American Railway Association, was held at St. Paul, Minn., the week of September 14, 135 master painters representing railroads in all parts of the country being in attendance. Much of the discussion centered on methods of painting railway equipment which would produce satisfactory results at the least cost and at the same time hold equipment out of service as short a time as possible while in the paint shop. Considerable emphasis was placed on methods of testing paints and several engineers of tests from various railroads discussed the problem of painting from this angle. Steps were taken to place railroad testing of paints on a more scientific basis.

The master painters were welcomed to St. Paul on behalf of the railroads by E. F. Flynn, assistant to the vice-president of the Great Northern, who made an inspiring address on the improved relations between American employers and employees which has taken place in recent years. He pointed out the dependence of each on the other and said that only by mutual helpfulness can American ideals and the present high standard of living be maintained.

During the meeting tribute was paid to Secretary V. R. Hawthorne when the members presented him with a solid gold railroad watch in token of appreciation for his faithful services in the interests of the Equipment Painting Section and its predecessor, the Master Car and Locomotive Painters' Association.

F. W. Bowers (Erie)
Chairman

A. E. Green (C. & N. W.)
First vice-chairman

James Gratton (B. R. & P.)
Second vice-chairman

Election of officers

The following officers were elected for the year 1926: Chairman, A. E. Green, foreman painter, Chicago & North Western, Chicago; first vice-chairman, James Gratton, general foreman painter, Buffalo, Rochester & Pittsburgh, Dubois, Pa.; second vice-chairman, F. E. Long, foreman painter, Chicago, Burlington & Quincy, Aurora, Ill. According to the regulations of the Section, the last two past chairmen automatically become members of the Committee of Direction, which together with the three above make the Committee of Direction of the Equipment Painting Section as follows: H. Hongeveld, master painter, Atlantic Coast Line, Waycross, Ga.; B. E. Miller, master painter, Delaware, Lackawanna & Western, Kingsland, N. J.; H. C. Allehoff, foreman painter, Oregon-Washington Railroad & Navigation Company, Portland, Ore.; L. B. Jensen, general foreman, passenger department, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.; D. C. Sherwood, foreman painter, New York Central, West Albany, N. Y.; J. McCarthy, foreman painter, Canadian National, Montreal, Que.; W. Mollendorf, foreman painter, Illinois Central, Chicago; G. H. Lehnen, foreman painter, Chicago & Eastern Illinois, Danville, Ill.; A. H. F. Phillips, foreman painter, New York, Ontario & Western, Middletown, N. Y.; Marceau Thierry, foreman paint shop, Norfolk & Western, Roanoke, Va.; J. N. Voerge, general master painter, Canadian Pacific, Montreal, Que.; and J. McDowell, foreman painter, Chicago, Rock Island & Pacific, Chicago.

Abstracts of several of the papers are given below. The papers dealing with testing will appear in a later issue.

Apprentice systems

By J. W. Gibbons

General master painter, Atchison, Topeka & Santa Fe, Topeka, Kan.

The writer has always advocated that for the first three years students for all crafts could and should have the same studies. The fourth year should be specialized along the lines of the craft he is learning. The painter apprentice should be taught free hand drawing, designing and elementary lessons in the chemistry of oils and pigments and their relative protective qualities. He should be encouraged to read well chosen text books containing

the fundamental principles of the painting craft. And as this may be considered the iron and steel age, he should be taught the elements that enter into their destruction and the best means of preserving them.

In addition to the school, the Santa Fe has shop instructors whose duty it is to teach the boys the practical side of the application of paint and designing of letters and ornamentation, as well as to emphasize the fact that the first and most essential reason for painting is preservation of the surface and that ornamentation is only a secondary consideration. It is up to the foremen and apprentice instructors to realize their responsibility in handling the apprentice assigned to them. We take the place of the teacher in educating the youth of today so he will be the craftsman of tomorrow. We teach him to breathe a soul into his work, in fact, the future of the boy is in our hands. The habits he forms as an apprentice will remain with him when he becomes a mechanic. If he learns to do work neatly and correctly as an apprentice it will be no trouble to do it when he graduates. If he gets the correct view of the relation a workman has to his foremen and instructors, he will retain it. If we treat him gruffly and instruct him grudgingly, he will assume that attitude toward us and our work. Worse than that, he will take it for granted that we are representatives of the company that employs us and he will become a pessimist as to the good faith in the promises of fair treatment made to all employees by higher officers. We can make the boy a good, loyal mechanic, or we can make of him an indifferent, careless workman, whose mind is in rebellion against all authority. A boy, unconsciously, is affected by examples of those around him, especially those who have authority over him.

Supervisors should always remember that it is their duty, not only to teach the boy a trade, but to build character, to assist the boy in acquiring a personality. Give him faith in humanity; make him a thorough craftsman.

Shop construction committee discusses mechanical painting

It is a well known fact that a shop of modern construction and equipment is a great help towards economy and efficiency. If a shop and its equipment are ancient, then economy and efficiency are crippled to some extent.

We understand that our railroads have not gone very deeply into the mechanical painting of passenger car bodies. We who have used the mechanical system of painting know of the many objectionable features when used inside of the shop buildings. The fumes and mist that arise from the operation endanger the health of the operators and those who are required to be in the immediate locality and the mist settles on other equipment. If mechanical painting is used to any extent, the work should be confined to a certain section of the shop provided with booths or screens to protect other equipment. This section should be ventilated with a vacuum system, so that the fumes and mist can be removed through the ventilators.

The mechanical painting of removable and small parts is being done by the use of different kinds of devices, and a great deal of thought, time and money have been expended by various concerns in the manufacture and improvement of mechanical painting devices. A number of railroads have made or are making trial applications with mechanical painting devices for locomotives and coaches with lacquers and different kinds of finishes. Pyroxylin finishes are now produced by a large number of manufacturers under many different trade names. About all of these materials are made on the general principle of a nitro-cellulose base dissolved in various liquids of a highly volatile and inflammable nature. The fire hazards involved are very great and great care should be taken in equipping the place or building with fire protection, where mechanical painting is done.

(The committee's recommendations relative to the design of the paint, cabinet and pattern shops, and also removing paint by the sand blast process, are the same as those made by the Committee on the Design of Shops and Engine Terminals at the 1925 annual meeting of the Mechanical Division, A.R.A. An abstract of this report was published in the July, 1925, *Railway Mechanical Engineer*, page 412.—Editor.)

The report was signed by the chairman A. H. F. Phillips, N. Y., O. & W.; O. S. Minnick, W. M.; C. E. Ream, Penn.; J. T. MacLean, B. & M., and W. F. James, A. C. L.

Maintenance and care of paint and varnish at terminals

Freight and passenger locomotives should be cleaned before every trip. Where a washing machine is available, the locomotive should be placed on a wash track and the drivers, trucks, frames, spring rigging and tender trucks washed. These parts should then be wiped with kerosene. Jackets, cabs and tenders should be wiped with waste saturated with renovator, followed by dry wiping with waste. The front end should receive a suitable front end paint, and where the paint shows a tendency to scale, it should be removed and cleaned to the bare iron and repainted before the engine is placed in service.

Passenger locomotives should be repainted every nine months. Freight locomotives every twelve months and switching locomotives every fifteen months. The painting of locomotives should be done in stalls partitioned off for this purpose which should always be properly heated, ventilated and lighted.

Exterior cleaning of passenger cars

The exterior of passenger cars are to be washed daily with cold water before the cars leave the terminals. The exterior of cars used in first class trains and main line service should be washed with a solution of oxalic acid every 30 days or when the condition of the cars demand it. After applying the acid and all grease and dirt has been loosened, the acid and dirt should be washed off with cold water. Care should be taken that no acid and dirt remains on the body of the car.

The solution of oxalic acid should be 20 lb. dissolved in 50 gal. of hot water. It must be thoroughly dissolved and allowed to cool and applied cold.

The bodies of passenger cars should be renovated after each periodical washing, as this will destroy the effectiveness of the acid and stop it from working into the open joints, window sash brads and open sheathing. To apply the renovator use a handful of waste moistened with renovator and after it has been applied, care should be taken to see that the surface is thoroughly wiped dry and clean with clean waste. First class cars should be washed with oxalic acid and renovated every 60 days. New and newly painted cars operating in first class trains and main line service, should not be washed until a period of 20 days has elapsed. Trucks should be sprayed or wiped with distillate oil and washed with soap and water. All washing compounds and soda solutions must be avoided, as these compounds will destroy the varnish and paint.

Interior cleaning of passenger cars

All passenger cars should be blown with compressed air and all dust removed, before washing the head lining, wall pipes, and seat arms. They should be washed with a

solution of soap and water, then rinsed and dried with a chamois skin. The solution of washing material should be put in one pint of diluted vegetable oil soap to a bucket of water. Floors should be mopped and care taken that not too much water remains on the floor, causing the floor to become water soaked, which is injurious to the under frames of passenger cars. Toilets, baggage and express car floors should be washed with a solution of one-half pint of disinfectant to 12 quarts of water. Vestibules should be washed with soap and water and dried with a chamois skin. The interior of the cars should be gone over with a suitable furniture polish or renovator when the varnish becomes dry and dull looking. This work should be done by experienced men.

Painting of passenger cars

Terminal painting—When the cars present a bad appearance they should be held out of service and have the parts repainted that demand it, at the coach yards. The painting of the roof, steps, trucks, vestibules, sash, head lining, seat arms, foot rests and guards, pipes, pedestal and floors, should be done under the supervision of experienced employees.

A great many railroads have applied lacquer to passenger cars for test purposes and your committee recommends that all such cars be washed with a solution of vegetable oil soap and rubbed thoroughly dry after each period of 30 days. The secret of success in the cleaning of this equipment is the thorough rubbing after it is cleaned, as this brings about a high gloss that is much desired.

The report was signed by G. Schwantes, chairman, C., M. & St. P.; J. J. McNamara, B. & O.; J. H. Whittington, C. & A.; J. McCarthy, C. N., and H. E. Brill, A., T. & S. F.

Report of committee on standards—Cars and locomotives

What success, if any, has been obtained to prevent paint peeling from galvanized iron car roofs?—It is the consensus of opinion of the committee that galvanized iron, when new, should only receive one coat of company standard paint for appearance sake. The result of tests shows that asbestos fibre cements have adhered better than the ordinary carbon blacks or oxide paints, and have proved more permanent.

The most practical and economical method of bringing up interiors of steel passenger coaches for graining or coloring.

First day—Sand blast and apply railroad company's standard steel car primer.
Second day—Stand to dry.
Third day—Apply coat of steel car surfacing.
Fourth day—Putty and knife where necessary.
Fifth day—Sandpaper and apply first coat of railroad standard enamel.
Sixth day—Stand to dry.
Seventh day—Apply finishing coat of enamel.
Eighth day—Apply standard ornaments, striping and necessary notices.

In cases where cars are to be grained, two coats of ground color should be applied, allowing 24 hours for drying between each coat; the first coat of ground color to be applied on the fifth day, instead of enamel. Then grain and apply the first coat of varnish. Apply the necessary ornaments and notices, followed by two coats of varnish.

Where rub finish is required, 48 hours should be allowed after the last coat of varnish. Rubbing should be done in accordance with railroad shop practice.

The most practical and economical method of bringing up the exterior of steel passenger coaches—Where finish and appearance would be acceptable to the railroad company officers, your committee would recommend the following system, as it would provide ample protection:

First day—Sand blast and prime with approved steel car primer.
Second day—Stand to dry.
Third day—Apply coat of steel car surfacing.
Fourth day—Putty and knife where necessary.
Fifth day—Sandpaper and apply coat of standard color semi-gloss and of sufficient covering qualities that one coat will cover.
Sixth day—Ornament and letter. If the shade of body color used requires two coats, the second coat of color can be applied in the morning and lettered on in the afternoon. Follow with two or three coats, in accordance with shop practice, of coach finishing varnish to be applied.

What is the most economical and practical material for passenger car headlinings?—This committee recommends from a maintenance standpoint agasote, panelyte or similar material, as the most economical and practical material for passenger car headlining.

Standard for painting of passenger and freight locomotive cabs, domes and tenders—This committee recommends the following system as a standard for painting of passenger and freight locomotive cabs, domes and tenders:

1—Sand blast should be used for removing all old paint and scale from the metal.
2—The primer and surfacers used should be all black in color. The reason for recommending black undercoatings is that one coat of black locomotive finish will cover more solidly, and abrasions will not show as readily as with lighter undercoatings.
3—After lettering, apply one coat of finishing varnish on freight and two coats on passenger locomotives. Both black locomotive varnish and finishing varnish should be resistant to either hot or cold water.

The report was signed by G. H. Lehnen, chairman, C. & E. I.; J. N. Voerge, C. P.; A. E. Green, C. & N. W.; D. C. Sherwood, N. Y. C.; K. J. Johnson, N., C. & St. L., and F. E. Long, C., B. & Q.

Painting of freight car equipment

A great majority of the new steel equipment is not being sand blasted before painting, causing the paint to peel in a short time. This committee considers it most important to sand blast equipment, whether new or old, before painting and then prime with an approved standard metal protector. A primer made of chromate of lead has been found to be very durable. For open top cars, this primer can be followed with two coats of carbon black.

On steel box cars, after sand blasting and priming, apply two coats of oxide of iron, thinned to a brushing or spraying consistency with two-thirds boiled linseed oil, and one-third thinning oil. All steel underframes should be sand blasted and coated with a good metal primer, followed with at least one coat of standard body color. We do not consider it necessary to paint trucks other than new.

Steel or galvanized iron roofs, after being sand blasted, should be primed with the same material as the body, followed by two coats of the railroad company's standard roof paint. All stencilling should be done with white lead in oil, thinned to stencilling consistency, with boiled linseed oil. On new box cars, the interior of all steel plates, posts, braces, etc., should be painted with a good metal protector and one coat of oxide of iron applied. A good heavy red lead, or satisfactory metal protective paint should be applied on all new cars where metal overlaps, or is joined.

We recommend the following for new wooden equipment: All steel underframes should receive the same treatment as for steel cars. The outside of the sheathing, and all sides of roof boards and saddles, should be primed

with oxide of iron and boiled linseed oil before being applied to the car, after which two coats of oxide of iron should be applied, thinned to a brushing or spraying consistency with two-third boiled linseed oil and one-third thinning oil.

Roofs, if wood, should receive the same treatment as the body of the car. If metal, the same treatment should be given as on steel equipment. All stencilling should be done with white lead in oil, thinned to a stencilling consistency with boiled linseed oil. In the maintenance of old equipment, all new work should receive three coats and old work two coats of oxide of iron. Underframes on old equipment should receive one coat of standard body color. Roofs should receive two coats of railroad standard roof paint.

Owing to the necessity of getting this equipment into service with dispatch, we recommend that all painting be done by the mechanical method. While climatic conditions on certain railroads may require a slight change in the outer coatings, the committee believes that the above would be a good general practice.

The report was signed by the chairman D. C. Sherwood, N. Y. C.; Edward McDade, G., C. & S. F.; E. S. Butcher, F. W. & D. C.; C. O. Smith, B. & L. E.; H. C. Allehoff, O. W. R.R. & N. Co.

Applying corrugated steel ends to box cars

THERE are many car repair yards having considerable work to do in repairing box cars, that are not provided with adequate crane facilities to handle the work and it is a difficult job to apply corrugated steel ends without the assistance of a crane. One car shop, however, has been able to perform this work quite effectively by means of the trestle and derrick shown in Figs. 1 and

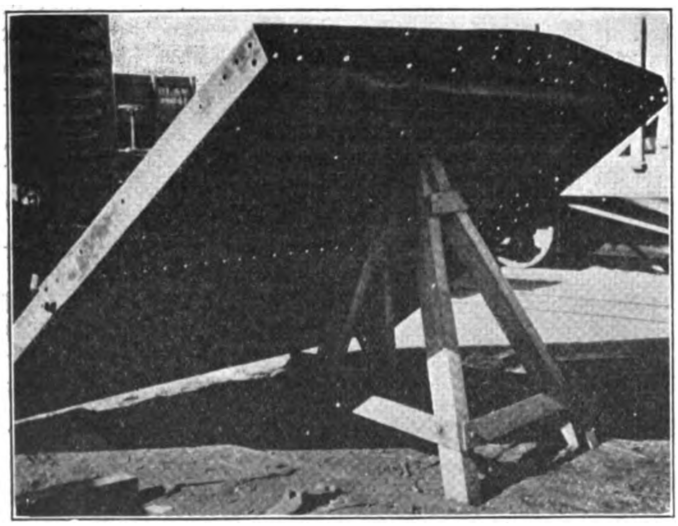


Fig. 1—The trestle holds the car end in such a position that the car repairman can work underneath

2, respectively. Referring to Fig. 1, the trestle is constructed with grooves in the top that fit the corrugations on the car end. The top is sloped so that the bottom of the car end rests on the ground and the top is elevated sufficiently so that a car repairman may work underneath.

Car ends are placed in position and applied by means of the derrick shown in Fig. 2. The derrick consists essentially of two timbers which form the legs and are braced by two cross-pieces. It is placed in position as shown in Fig. 2, and held by blocks and tackle, one block is secured to the top and the other to an adjacent car.

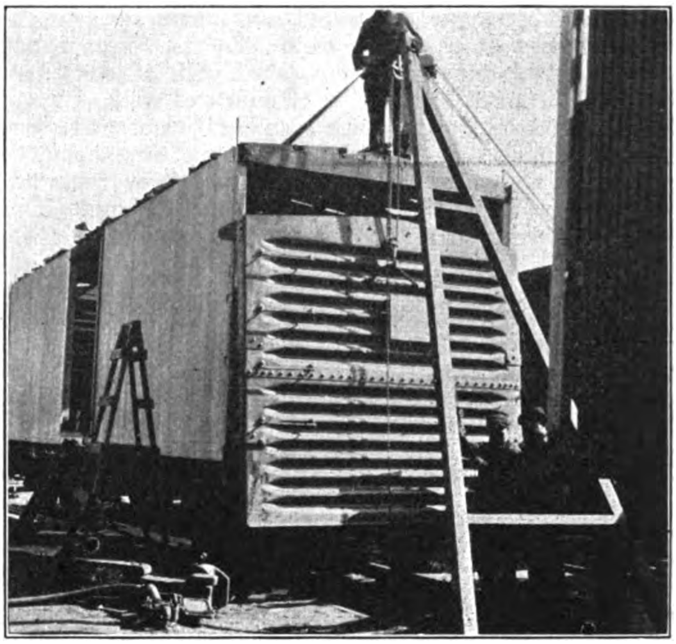


Fig. 2—Applying a corrugated steel end with a derrick and chain hoist

In this way the derrick may be adjusted to any height desired. The car end is then raised to position with a chain hoist.

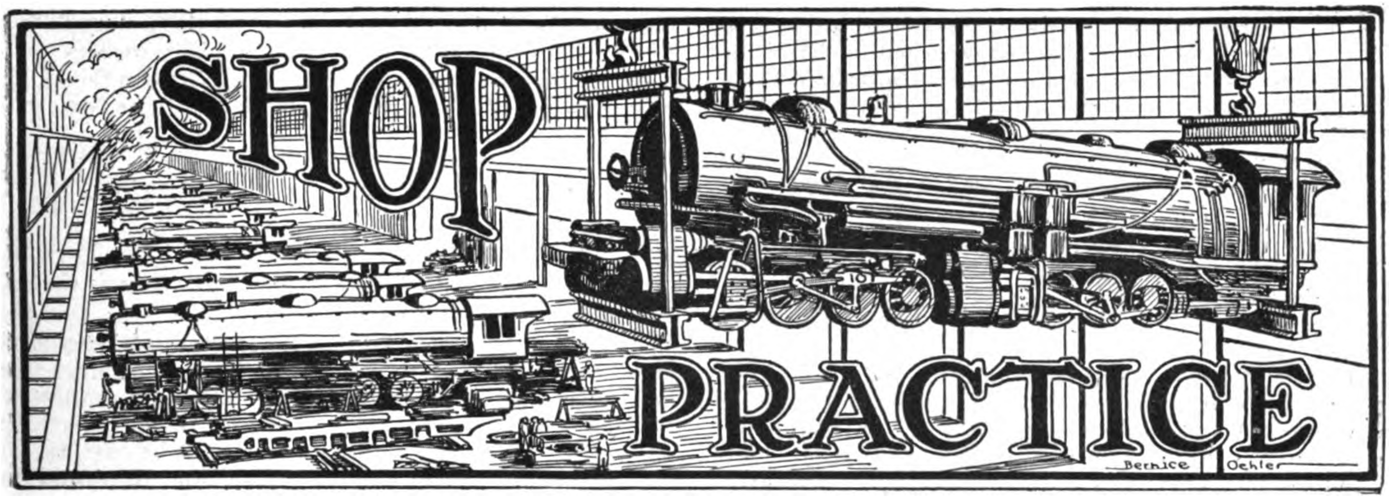
Perpetual examination of brasses*

DURING the past few months I have observed a practice which may be termed "perpetual" rather than "periodical" examination of brasses. The method appears the most logical of any I have studied and is bringing splendid results. A "hot box" out of the terminal coach yard is a rare occurrence.

Instead of examining the coaches in the yard when the journals are cool, an inspector of unquestioned ability is stationed at the terminal depot, where the journals can be examined immediately on arrival of the train when they are still at a running temperature. The inspector feels every journal, in addition to making a careful visual examination. When he finds a journal warmer than normal, he marks the box for examination, knowing there must be something which caused the excessive heat, not necessarily knowing what. This box is jacked up when the car reaches the coach yard, the trouble ascertained and the remedy applied.

There are a great many terminals, both passenger and freight, where this could be followed and a "perpetual" examination of brasses made which might make unnecessary the "periodical" examination. It would seem more dependable to determine conditions by actual running temperatures than by a "cold" examination, which will not disclose many defects, such as cracked linings, defective wedges, too old "dope," etc. A high running temperature does indicate one or more undesirable and possibly dangerous conditions.

*An extract from a paper by W. H. Davis, service engineer, Universal Packing & Service Company, Chicago, entitled "Practical lubrication of railway equipment," read December 1, 1924, before the Cleveland Steam Railway Club at Cleveland, Ohio.



Tool foremen meet at Chicago

Thirteenth annual convention best attended and most interesting recently held

THE thirteenth annual convention of the American Railway Tool Foremen's Association, held September 2 to 4 at the Hotel Sherman, Chicago, surpassed both in point of view of attendance and interest in the valuable reports and papers presented, any convention of this association held in recent years. The opening address was made by H. T. Bentley, general superintendent of motive power and machinery of the Chicago & North Western, who commented on the importance of the work of railway tool foremen and pointed out the opportunity which they have of saving money for the railroads by providing more efficient tools with which employees in shops and enginehouses can work. The tool foreman's responsibilities were discussed by G. T. Martin, assistant to the general superintendent of motive power of the Chicago, Milwaukee & St. Paul, and the proper machine equipment for toolrooms by C. A. Shaffer, general supervisor of shop machinery and tools of the Illinois Central. E. J. McKernan, general supervisor of tools of the Atchison, Topeka & Santa Fe, discussed "Economies possible by standardized small tools," and E. L. Woodward, western editor of the *Railway Mechanical Engineer*, read a paper entitled, "The importance of the toolroom to the railroads," emphasizing some ways in which the toolroom can be operated to help reduce shop and enginehouse costs. E. A. Hildebrandt, tool foreman of the Cleveland, Cincinnati, Chicago & St. Louis at Indianapolis, presented some pertinent remarks on "Co-operation." An abstract of the papers and reports presented at the convention will appear in this and subsequent issues of the *Railway Mechanical Engineer*.

Election of officers

The new officers of the association elected for 1926 are as follows: President, E. A. Hildebrandt, tool foreman, Cleveland, Cincinnati, Chicago & St. Louis, Indianapolis, Ind.; first vice-president, O. D. Kinsey, general supervisor of tools, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.; second vice-president, E. L. Graeme, tool foreman, Delaware, Lackawanna & Western, Scranton, Pa.; third vice-president, W. R. McMilligan, tool foreman, Missouri-Kansas-Texas, Parsons, Kan. G. G. Macina, Chicago, Milwaukee & St. Paul, Chicago, was elected permanent secretary-treasurer of the association. The newly elected executive committee consists of E. C. Heingarten, (C. & N. W.), M. J. Harney, (N. Y., N. H. & H.), J. T. Sumner, (M. C.), L. C. Brown, (C. B. & Q.), and W. J. Hynes, (M. P.).

The tool foreman's responsibilities

By G. T. Martin

Assistant to general superintendent of motive power, Chicago, Milwaukee & St. Paul, Chicago

To obtain a practical demonstration of the tool foreman's responsibility, it is only necessary to be close to a job where a mechanic is trying to do a day's work, with a motor that will not function properly, or a reamer that fails to cut or perhaps an air gun that fails to do business. In cases of this kind, the tool foreman's responsibility is fully and clearly established in the mind of the man operating such tools. What he is saying about the tool foreman would, in my opinion, be too spicy to appear in print.

Conditions of this nature cannot generally be charged against the tool foreman because in my experience I never found a real tool man who would willingly allow tools in his cars to get in such condition. In a shop where poor tools are in evidence to any great extent, the responsibility for such conditions generally rests upon the local or general officers. Either they fail to secure a competent tool man who can remedy the situation, or they fail to furnish proper facilities whereby a competent man can accomplish this task.

Many conditions contribute to the responsibilities of the tool foreman. The railroads are still struggling through a period which has demanded the greatest courage and resourcefulness on the part of the executives to meet the demand made on them for handling the country's transportation, without having the power to establish or secure competent returns to cover the ever increasing expense of operation.

In 1923, the railroads of this country attained a record that has heretofore never been approached in the history of transportation. The service rendered measured by the number of tons of revenue freight moved one mile, showed an increase of sixty billion net ton-miles greater than was moved in 1916. In hauling this great volume of business, the net revenue obtained was something like seventy-eight million dollars less than that obtained for handling the transportation business on the railroads in 1916. The year 1924 and the first half of 1925 show a marked decrease in tonnage available, resulting in a greater necessity for added returns to overcome deficits in net earnings in the future.

I touch on this important subject to reflect, if I can, the necessity of every man in all branches of the service realizing his full responsibility, in order that each unit may develop the highest standard of efficiency.

As mechanical men, one of our important problems is to increase the output of shops, roundhouses and repair yards, in order to cut maintenance costs to the very minimum. In this respect, the tool foreman plays a very important part. Assuming the best possible facilities and maintenance forces comprising workmen carefully selected, well organized and properly supervised, it will then depend on an adequate supply of properly maintained tools if our repair costs are to be brought to a minimum. Without sufficient well kept tools, no shop can hope to maintain its share of responsibility in output.

The tool foreman's responsibility rests largely in his ability to organize, develop, perfect and promote the thought, plan, device or organization connected with the successful maintenance of an up-to-date, adequate tool supply. We know that often tool foremen are held responsible for the condition of tools which have long outlived their usefulness. Those of us who have had practical experience realize that the tool foreman is often held responsible for tools which apparently have not held up under the strain or speeds for which they were built, owing to improper heat treatment or carelessness in manufacturing. Often you are held responsible for damage to tools on account of excessive speeds of motors, presses or machines when using drills, taps, dies, reamers, cutters, etc., when in reality the responsibility in these matters rests to a large degree on the lack of co-operation shown the tool foreman when he has intelligently brought the subject to the attention of his superior officer.

To have good tools available at all times requires a definite skilled organization. In this day and age, no man can do all the work or assume all the responsibility. He must of necessity depend upon his associates who comprise his organization and keep before them the motto of this association—"Higher efficiency in the railway tool service."

Chas. E. Helm (C. M. & St. P.)
President

E. A. Hildebrandt (C. C. C. & St. L.)
1st Vice-president

G. G. Macina (C. M. & St. P.)
Secretary

Machine equipment for the toolroom

By C. A. Shaffer

General supervisor of shop machinery and tools, Illinois Central, Chicago

In the apparent increasing tendency toward better and more complete shop machinery and other facilities for making repairs to locomotives and cars, the matter of suitable equipment for the maintenance of all tools with which that work must be done, should not be overlooked.

In the past, it is quite evident that due consideration has not been given to equipping the tool department to the best advantage for making and maintaining in first class condition such tools as may be required. This is true of many shops from the largest to the smallest, and, at the present time, when the importance of good tools is being generally recognized, it may not be amiss to discuss the question of toolroom machinery.

The tool department of any railroad shop should be adequate to maintain all tools used locally or under that shop's jurisdiction properly and economically, and in order to keep pace with improvements made in design, and the increased size of machinery and tools for handling modern locomotives, it is necessary that corresponding attention be given to the equipment for maintenance of such tools.

Obviously, it is impossible to work out a definite list of machinery and equipment which would be practicable to meet requirements for all shops because of the various methods used by different railroads for handling this work, also the kind and amount of work to be done and local conditions governing. Therefore, it would seem desirable to submit possibly three groups of equipment for consideration either separately or in combination of items from one or more groups as may be best suited to meet the requirements of individual cases.

Some of the larger railroads make it a practice to have centralized toolrooms, usually located at their main shops, where certain standardized tools are made for the entire railroad and shipped to the different points on requisition. These are generally known as manufacturing toolrooms.

and require somewhat greater and more diversified lots of equipment than the tool departments where only maintenance or reconditioning work is done.

However, the majority of railroads have tool departments at their main shops where all local tool maintenance and repairs are taken care of, and, possibly, some new work in emergency cases or for occasional replacements.

Group No. 1.—Equipment for general tool manufacturing and maintenance department

Item No.	Nominal size	Type and kind of machine	Special equipment or extra attachments
1	20-in. by 10-ft	Engine lathe	Taper attachment; 16-in. four jaw independent chuck.
2	18-in. by 8-ft	Engine lathe	Taper attachment; 14-in. four jaw independent chuck.
3	16-in. by 8-ft	Toolroom lathe	Taper attachment; draw-in attachment; universal relieving attachment and one universal, and independent chuck.
4	14-in. by 6-ft	Toolroom lathe	Taper attachment; draw-in attachment; universal relieving attachment and one universal, and independent chuck.
5	10-in. by 4-ft	Precision tool maker's lathe	Complete.
6	3-in. by 36-in	Turret lathe	Bar stock and chucking equipment.
7	No. 4	Horizontal, knee type universal milling machine.	
8	No. 3	Horizontal, knee type universal milling machine.	
9	No. 2	Horizontal, knee type universal milling machine.	
10	No. 4 or No. 5	Vertical milling machine.	
11	24-in.	Crank shaper	
12	16-in.	Crank shaper	Universal table.
13	10-in.	Vertical shaper or slotter.	Angle adjusting head; universal table.
14	24-in. by 2-in. capacity	Radial drill press	Reversing attachment.
15	20-in. by 1¼ in. capacity	Upright drill press	Reversible; compound table; universal vise.
16	14-in. by ½-in. capacity	Precision speed drill	With square and round tables; "V" cup and point center.
17	12-in. by 36-in	Extra heavy duty universal grinder	Internal and radius attachments.
18	10-in. by 36-in. by 24-in. table travel	Medium service universal cutter and reamer grinder	Complete with power and hand feeds with all attachments.
19	8-in. by 24-in	Automatic wet surface grinder	Universal vise; magnet chuck.
20		Heavy universal tool grinder	
21	¼-in. to 3-in. capacity	Twist drill grinder	
22	Capacity up to 3 in.	Tap grinder	
23	Capacity for all sizes.	Universal die chaser grinder	
24	9-in.	Disc and belt grinder, polisher and buffer	
25	10-in. by 1-in. wheels.	Double floor stand grinder	
26	14-in. by 2-in. wheels.	Double floor stand grinder	
27	Medium size	Floor stand type arbor press	
28	6-in. capacity	Power hack saw	
		Heat treating equipment	
29	8-in. by 12-in. by 26-in.	Furnace	Electric or gas.
30	4-in. by 8-in. by 12-in.	Furnace	Electric or gas.
31	10-in. by 24-in.	Crucible	
32	12-in. by 18-in. by 24-in.	Furnace	Auto. electric tempering.
33	24-in. by 36-in	Oil immersion tank	36-in. by 36-in. water jacket.

Miscellaneous

Air flow meters.
Air tool testers.
Scleroscope and other measuring or testing instruments.

In selecting a list of toolroom machinery, there are a number of important points to be considered, the principal ones being: (1) Will manufacturing of new tools be done and if so, what kind and to what extent? (2) Will all classes of work pertaining to the upkeep of tools for every department be performed? (3) Equipment should be practical both as to size and design with a view to future requirements or expansion.

For the above groups, the following machines are suggested. The description of individual items is brief and confined to the kind or type of machine and principal dimensions or features. The maker's name has been purposely omitted. All machines should be individual motor-driven and equipped with suitable push button control. For convenient reference, the machines are classified and listed by consecutive item numbers.

Group No. 2.—Equipment for medium size shop doing mostly maintenance work

Item No.	Nominal size	Type and kind of machine	Special equipment or extra attachments
1	20-in. by 10-ft	Engine lathe	Taper attachment; 16-in. four jaw independent chuck.
2	14-in. by 6-ft	Toolroom lathe	Taper attachment; draw-in attachment, universal relieving attachment, and one universal and independent chuck.
3	No. 3	Horizontal, knee type universal milling machine.	
4	16-in.	Crank shaper	Universal table.
5	20-in. by 1¼-in. capacity	Upright drill press	Reversible; compound table; universal vise.
6	10-in. by 36-in. by 24-in. table travel	Medium service universal cutter and reamer grinder	Complete with power and hand feeds with all attachments.
7	¼-in. to 3-in. capacity	Twist drill grinder	
8	Capacity up to 3-in.	Tap grinder	
9	Capacity for all sizes.	Universal die chaser grinder	
10	14-in. by 2-in. wheels.	Double floor stand grinder	
11	Medium size	Floor stand type arbor press	
		Heat treating equipment	
12	8-in. by 12-in. by 26-in.	Furnace	Electric or gas.
13	4-in. by 8-in. by 12-in.	Furnace	Electric or gas.
14	24-in. by 36-in	Oil immersion tank	36-in. by 36-in. water jacket.

Miscellaneous

Air flow meters.
Air tool testers.
Scleroscope and other measuring or testing instruments.

Regarding the first group of equipment in the above list (comprising 33 items), it should be remembered that while the number of machines may appear excessive, an outfit about equal to this would be required to handle properly the work of manufacturing on a paying basis, certain new tools, such as reamers, cutters, taps, forging dies, jigs, fixtures and other special tools in quantities for general use at all shops, in addition to maintaining all local tools. It is believed, however, that the necessity for manufacturing such tools as reamers, taps, drills, threading dies, etc., is diminishing and the possibilities for effecting savings in this line are very remote. This is due to keen competition among commercial manufac-

Group No. 3.—Equipment for smaller shop where the only work done is reconditioning of tools generally used on running repair work

Item No.	Nominal size	Type and kind of machine	Special equipment or extra attachments
1	20-in. by 10-ft	Engine lathe	Taper attachment; 16-in. four jaw independent chuck.
2	20-in. by 1¼-in. capacity	Upright drill press	Reversible; compound table; universal vise.
3	10-in. by 36-in. by 24-in. table travel	Medium service universal cutter and reamer grinder	Complete with power and hand feeds with all attachments.
4	¼-in. to 3-in. capacity	Twist drill grinder	

turers and the fact that several reputable concerns are now listing as standard such tools as were considered special a few years ago and were priced accordingly.

There are many special time-saving tools and devices which had their origin and development in the railroad shop being manufactured and used today, which cannot be obtained elsewhere. These, together with forging and forming dies or other equipment of similar construction, give reason for a full complement of machinery in the tool department of an up-to-date railroad shop.

In the second group (comprising 14 items) is shown such machines as may be considered adaptable for the average medium-size shop to take care of occasional replacements and specialties in the way of new tools and the complete repairs and reconditioning of existing equipment.

The third group (comprising only four items) is suggested for outlying shops to handle limited light repairs to local shop equipment and sharpen such hand tools as drills, reamers, taps, thread chasers and cutters which would otherwise have to be shipped to a larger shop for reconditioning.

Report on shop jigs and devices

If some shop jigs and devices are not direct labor savers, they perform certain operations more uniformly and correctly than would otherwise be possible and therefore help increase the efficiency of shop operation and reduce costs. The jigs and devices shown in the accompanying illustrations have been developed and are used successfully at various points on the Santa Fe, notably San Bernardino, Cal., and Topeka, Kan.

A device for repairing the worn tender conveyor screws of Duplex stokers is illustrated in Fig. 1. The mechanically guided oxy-acetylene cutting torch cuts off the worn part of the top of the screw at a uniform distance from the center line and a steel strip subsequently welded to the conveyor screw brings it back to the standard diameter. Referring to the illustration, it will be noted that the conveyor screw is capable of rotation between centers on an iron frame-work supported on two wooden blocks. A carriage with an adjustable clamping arrangement to hold the cutting torch moves parallel with the center line of the conveyor screw, being guided by four flanged wheels which roll on the bed plate of the device. A vertical projection on the carriage carrying a taper roll at the top governs the horizontal movement of the carriage by bearing on the spiral of the conveyor screw and keeps the torch tip at the proper distance for effective cutting. In other words, starting with the torch at the right end of the conveyor screw, revolution of the screw will push the carriage with the torch attached to the left, the tip of the torch always remaining at the same distance from the spiral which is being cut. The speed of revolution of the conveyor screw is adjusted to that required for efficient operation of the cutting torch.

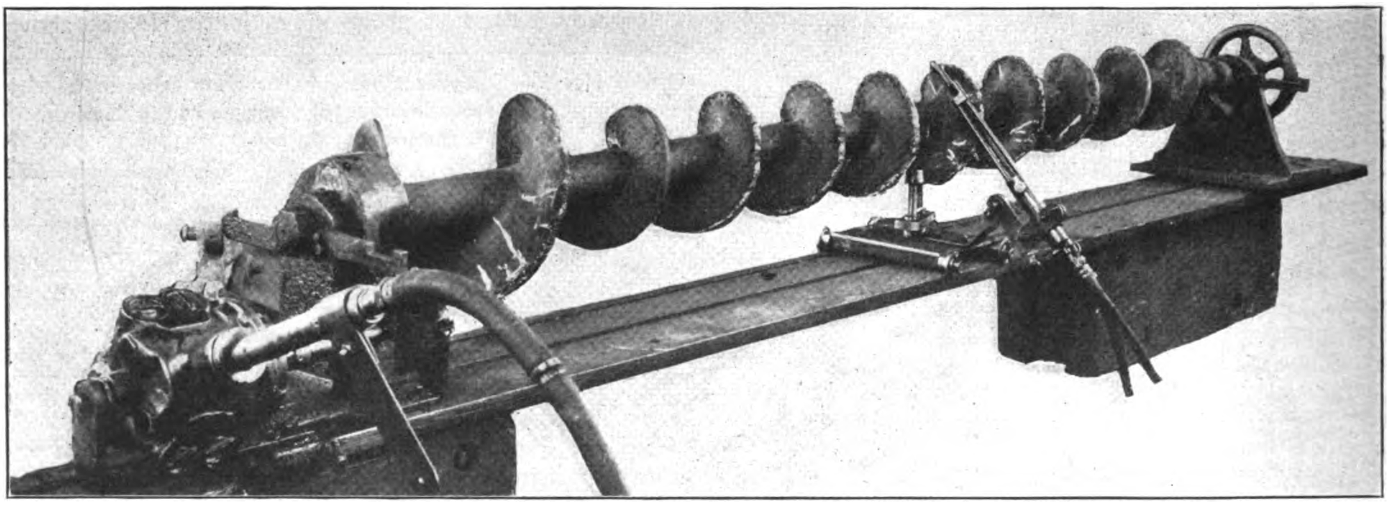


Fig. 1—Device for cutting off the worn part of Duplex stoker conveyor screws

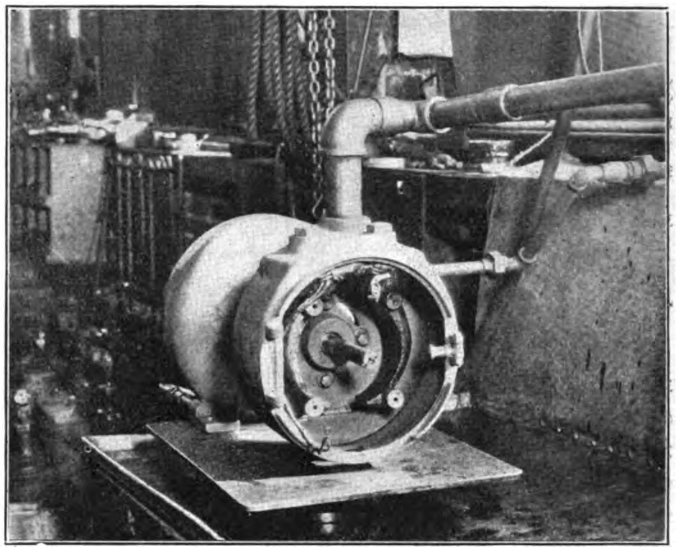


Fig. 2—Turning platform and work bench for repairing headlight turbines

A turning platform and work bench for use in repairing and testing headlight turbines is illustrated in Fig. 2. The platform turns on ball bearings and its use materially facilitates handling the turbines on the bench.

An ingenious and effective drill press clamp is illustrated in Fig. 3, clamps of this type being used on most of the drill presses in the Topeka shops for holding work. Bolts, U-clamps and blocks are largely eliminated, and set-up time is reduced proportionately. The construction of the clamp is plainly shown in the illustration, pressure on the work being obtained by pneumatic pressure in the cylinder, with a taper block on the end of the piston acting on the rigid right angle arm. Two substantial rolls on each side of the taper block reduce friction. A suitable

collar and retaining spring keeps the right angle arm up against the heavy 2½-in. nut, out of the way of any work on the drill press table while arranging the set-up.

Another device which assists in handling drill press work is the jig illustrated in Fig. 4. The length of time required for blocking up work at an angle on the drill press table is well known, and moreover, without the

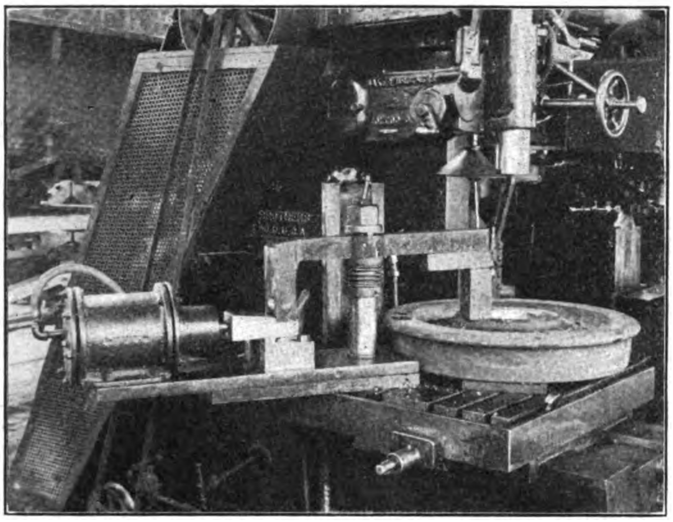


Fig. 3—Set-up time is saved with this pneumatic drill press clamp

exercise of considerable care and skill there is danger of ordinary blocks slipping and resulting in drill breakage. The jig illustrated consists simply of a bracket bolted to the drill press table with an auxiliary table capable of tilting at any angle. For drilling small holes such as oil holes in the spring hangers illustrated, simply tighten the two nuts on the bolts on which the auxiliary table pivots.

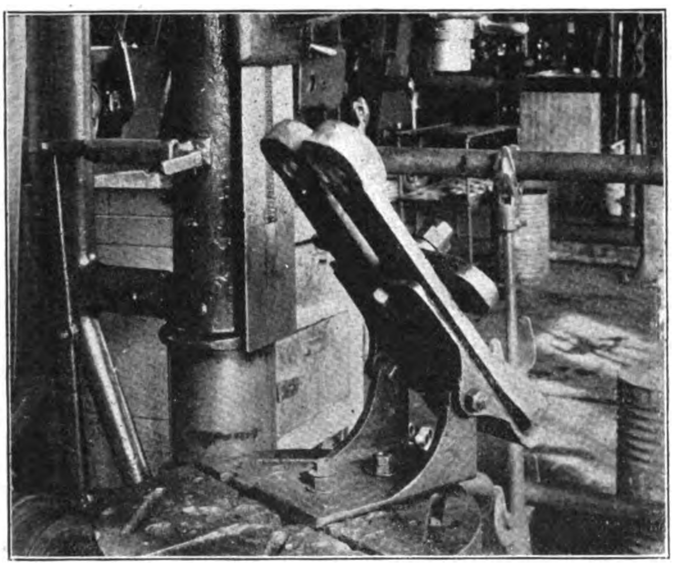


Fig. 4—Convenient drill press jig for drilling oil holes in spring hangers

This will develop sufficient friction to hold the table at any desired angle.

A convenient device for removing gears from a stoker shaft or other similar part is illustrated in Fig. 5. The framework of the device consists of a substantial U-shaped forging with the two ends turned over to form jaws and an accurately-cut 1½-in. screw threaded through a hole in the head of the puller. Any drive or force fit which is within the capacity of the device can be readily broken.

A particular advantage is its portability. It can frequently be used for removing gears in difficult places

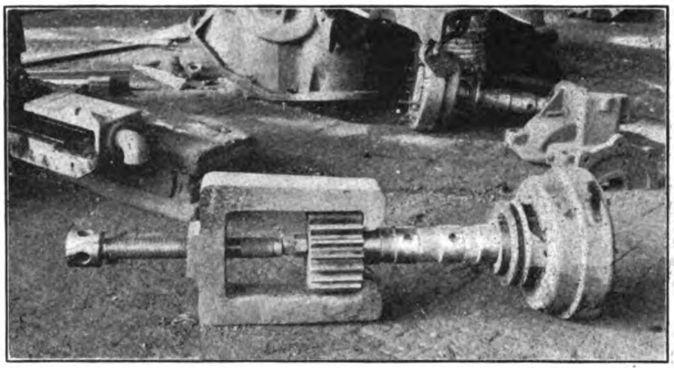


Fig. 5—Screw puller for removing gears from stoker shafts and other similar work

which would otherwise require dismantling the entire machine in order to take the particular shaft involved to the hydraulic press.

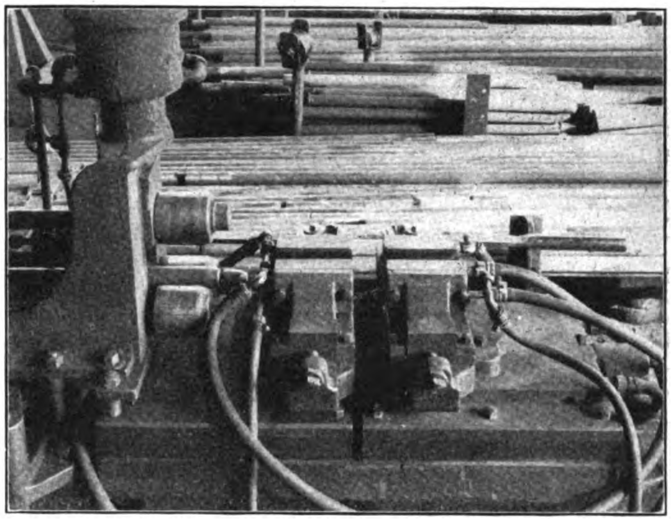


Fig. 6—Three-point roller as applied to modern electric flue welding machine

A three-point flue roller used with an electric welding machine is illustrated in Fig. 6. This device will roll the welds on flues smoother (on the inside as well as the out-

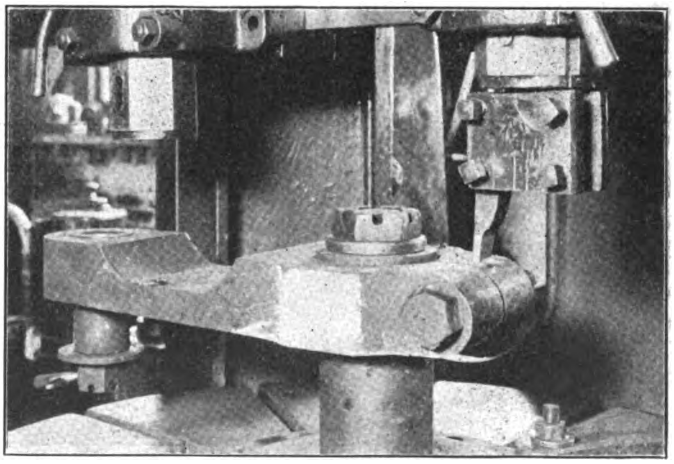


Fig. 7—Jig for holding eccentric crank arm while facing on boring mill

side) and do better work than with the old style roller.

A convenient jig for holding eccentric crank arms while being faced in a boring machine is illustrated in Fig. 7. By means of this jig the crank arm is easily and accurately set.

Some of the simplest shop devices are the ones which in the aggregate prove most effective and the chuck for turning and holding boiler check valves in a lathe, as illustrated in Fig. 8, may be taken as an example. This device permits the valves to be machined accurately and

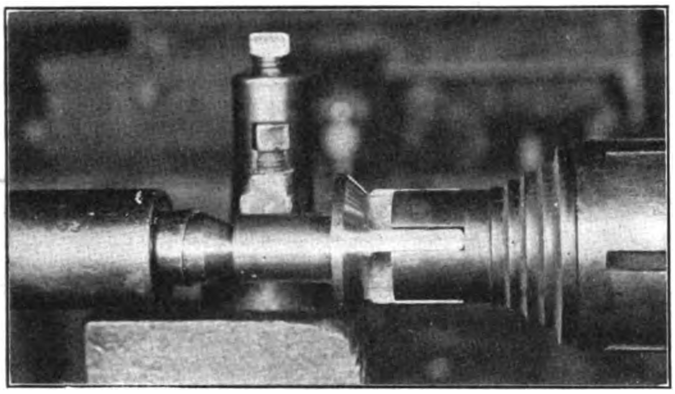


Fig. 8—Special lathe chuck for holding boiler check valves while being machined

in a minimum time. They are easily slipped in place and taken out again at completion.

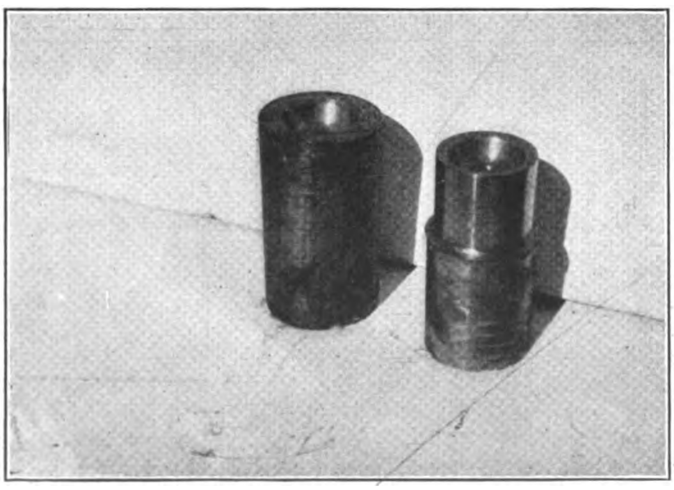
This report was signed by the chairman of the committee, Henry Otto, tool foreman, Atchison, Topeka & Santa Fe, Topeka, Kan., who requested that the association express its appreciation to J. R. Phelps, shop apprentice instructor of the Santa Fe at San Bernardino, Cal., for his able assistance in collecting data and photographs of many of the shop kinks.

Crank pins machined with counterbored ends

By J. Robert Phelps

Apprentice instructor, A. T. & S. F. shops, San Bernardino, Cal.

THE machining of locomotive crank pins in job lots is one of the common jobs in the locomotive repair shop. Considerable time can be saved in these



Finished and semi-finished crank pins with the ends drilled and counterbored

shops by adopting the following methods. The pins are first roughed out on a lathe and are then taken to a drill press where they are drilled and counterbored on both ends. The pins are now ready to be turned according to the sizes furnished by the wheel gang.

The lathe operator places the crank pins on the lathe centers in the holes which have been previously drilled in the pins. When the pin is finished, to size, its outside surface is true with the hole and the counterbore and is ready to be pressed in by the wheel press, thus eliminating any waiting at the last minute on the part of the wheel gang for the pins to be drilled. The machining of crank pins in this manner fits in well with the practice of keeping on hand a number of pins and axles all finished except for the wheel fits.

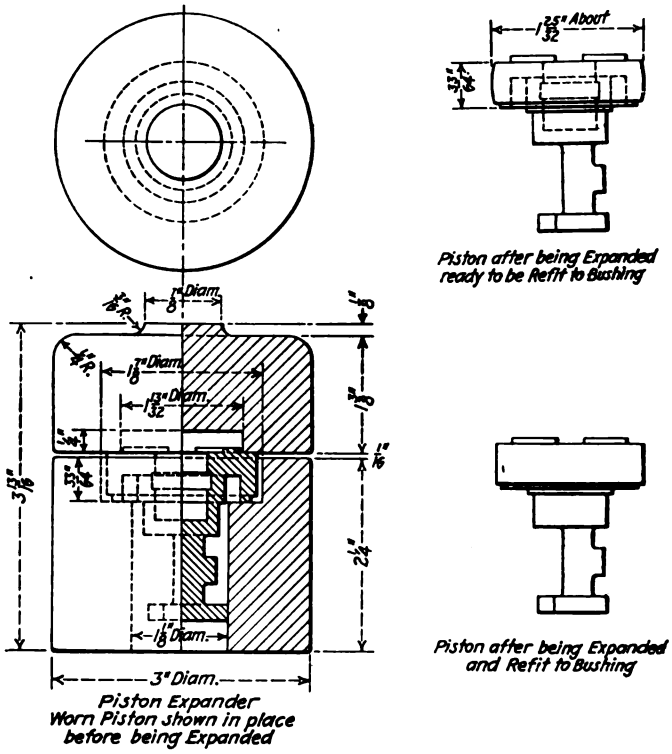
Piston expander for reclaiming feed valves

By N. T. Cline

Air brake foreman, P. & L. E., Pittsburgh, Pa.

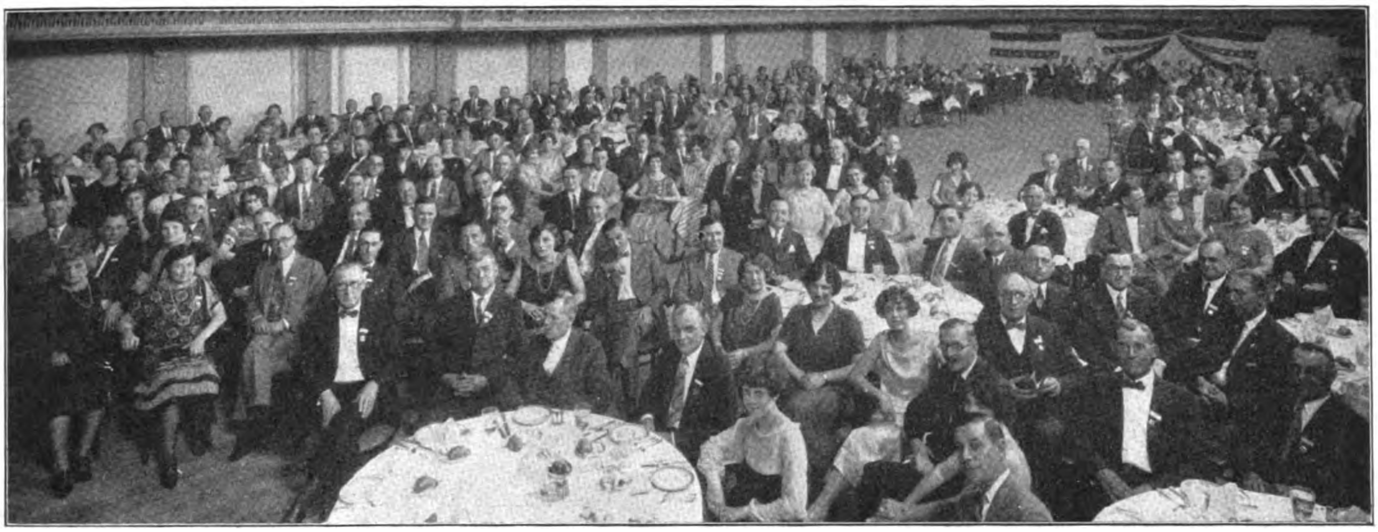
THE device shown in the drawing will be of benefit to air brake repairmen who are engaged in the repair and reclamation of air brake material. It has been used for reclaiming worn out *C*-6 and *B*-6 feed valve pistons at these shops for a number of years and has been found to be quite efficient for this work.

The operation of the device is simple and fast. Pistons



Device for reclaiming worn out C-6 and B-6 feed valve pistons

which have been worn down too small for further use are inserted in the device, as shown in the drawing, and the cap is placed on the top. The device is then placed under a hydraulic or air press that has sufficient capacity to force the two parts together. This causes the metal in the piston to expand sufficiently to permit machining to the proper size. The thickness of the piston is slightly smaller after this operation but the difference is so slight that it does not interfere with the operation of the valve. The two operations of expanding and machining take about six minutes.



Annual banquet of the International Railway General Foremen's Association, Hotel Sherman, Chicago, Ill.

General foremen meet at Chicago

Report is made on supervision of repairs to special locomotive appliances—Six other topics discussed

SIX reports were discussed at the nineteenth annual convention of the International Railway General Foremen's Association held at the Hotel Sherman, Chicago, September 8 to 11, inclusive, as follows: Automatic Train Control, Supervision of Repairs to Special Locomotive Appliances, Straightline or Spot System of Car Repairs, What Can the General Foreman Contribute to Obtain More Ton Miles per Shop Man Hour, Reclamation of Car and Locomotive Material, and Best Routing System to Increase Shop Output. A feature of the convention was the address on the third day by Roy V. Wright, editor of the *Railway Mechanical Engineer,* who made a strong appeal for a higher type of leadership in the railroad mechanical field, and pointed out the urgent need of definite plans for building men for the future. An abstract of Mr. Wright's remarks is presented below.

Election of officers

The officers of the association for 1926, most of whom were re-elected, are as follows: President, H. E. Warner, New York Central, Elkhart, Ind.; first vice-president, C. A. Barnes, Chicago & Western Indiana, Chicago; second vice-president, F. M. A'Hearn, Bessemer & Lake Erie, Greenville, Pa.; third vice-president, C. F. Bauman, Chicago & North Western, Winona, Minn. William Hall, Chicago & North Western, Winona, Minn., is permanent secretary-treasurer. William Mulcahy, Baltimore & Ohio, Garrett, Ind., and B. L. Davies, Baltimore & Ohio, Hammond, Ind., were replaced on the executive committee by J. N. Chapman, Illinois Central, Water Valley, Miss., and H. Keys, Baltimore & Ohio, Baltimore, Md.

Leadership—Building men for the future

By Roy V. Wright

Editor, Railway Mechanical Engineer

Many things have happened in the past 10 years which have brought about radical changes in railroad shop methods, practices and administration. The shop crafts strike, for example, in 1922 proved to be a terrible experience for both the men and the managements. It had one lasting and beneficial result. It forced both sides to face the situation squarely and to do some real thinking about their mutual relationships. The year 1922 will in all probability mark the passing of large strikes and lockouts in the railroad field. We are going back into the dark ages when we attempt to settle differences by brute force. There is no winner in such a contest—both sides lose, regardless of which one may come out ahead.

"If a house be divided against itself, that house cannot stand." We are coming into a period of co-operation. The ownership of a corporation or railroad is vested in so large a number of people that the executives act in the capacity of trustees and are just as much employees as are the workers in the ranks. In a very real sense, therefore, the executives and representatives of the managements and the workers are *co-workers.*

We now have several different types of co-operative endeavor in the railroad shops, extending all the way from organized co-operation on the part of the labor unions to various forms of so-called employee representation. All of these methods tend to emphasize the importance of the human element in the organization and to restore to some small degree, at least, that intimate contact between the management and the worker which was lost with the coming in of the present industrial age. Then, too, the limelight has been focused on the keystone of the arch in the organization—those men, foremen and subordinate supervisory officers, who come in intimate contact with the workers and lead them.

The foreman and his training

These foremen have the responsibility of interpreting the policies of the management to the men and in turn interpreting the needs of the men to the management. They hold a most vital and strategic position. It would seem that they should be selected only with the very greatest care and that they should receive a most careful course of training in leadership.

A bright young man oft-times in these days with a high

school training, will go into a shop and spend four years as an apprentice in training to become a mechanic. He has much to learn and at the end of his apprenticeship is still in many respects just a beginner. He does possess a certain degree of manual skill and understands how to operate certain machines and equipment. If he continues to develop, becomes a master craftsman and has a good personality, he may become a gang leader or foreman—indeed, if he is willing to study and work hard and possesses any great degree of executive ability, he may climb far up the ladder of success.

There is no more delicate or complicated piece of mechanism than the human being and no two individuals are alike. Treated and directed rightly, a worker will function with enthusiasm and great efficiency—misunderstood, even to a slight degree, and his efficiency and interest may fall off greatly. Surely, if it takes four years to make a mechanic who must deal with inanimate objects and operate relatively simple machines, it should take years of careful and painstaking work to prepare a man for a position in which he must lead and direct his fellow workers.

How much special training of this sort must a man have to qualify for the position of foreman? You know even better than I do how much he gets. It is, of course, true that certain men are born with the faculty of understanding their fellows and are natural leaders. They are comparatively few in number, however, and even these fortunate ones can benefit greatly by understanding clearly the basic principles upon which successful leadership rests. Not so many years ago people would have smiled if management had been referred to as an art or a profession. Today it is recognized more and more generally as a science.

Have we not a real task before us in training men who must occupy positions of leadership in the future and of helping those who now hold supervisory positions to take advantage of the great amount of information which has been developed in recent years on the art of human leadership?

This information is available for several sources and in different ways, if we will but busy ourselves to take advantage of it. On one road, at least, successful foremen training classes have been conducted under local leadership, but with the aid of a course provided by the extension department of a state university. Other universities have similar courses and I know of at least two different railroad points which are going to put on foremanship training courses this fall with the aid of the state universities.

Then there are a number of roads on which foremen's clubs have functioned. The programs of the staff meetings on many roads have been broadened to include discussions of problems relating to successful leadership. Several correspondence school study courses on foremanship training are available. Some roads believe in sending their foremen and officers to visit shops on other roads in order that they may broaden their ideas and see how other shops are administered. A few mechanical department officers are asking their associates to present written criticisms of articles in the technical papers or reports before railroad clubs or other organization. At least one of these officers is concentrating this sort of a campaign on articles relating to foremanship training. There are other ways in which the foremen are being assisted in getting a better idea of the principles underlying successful leadership, as well as on up-to-date methods and practices. I imagine a most productive session of this convention could be entirely devoted to the exchange of practical experience on this question.

Getting back to the very root of the matter, several mechanical department officers have suggested that the best type of foreman can only be produced by selecting the apprentices with the greatest possible care and then giving them a thorough apprentice training along the lines which have been so well worked out on the Santa Fe. I shall not attempt now, however, to discuss this matter of apprenticeship. For at least a quarter of a century the *Railway Mechanical Engineer* and its predecessors have consistently and aggressively advocated more modern apprenticeship training methods. Some progress has been made in this quarter of a century, but it is only within the past two or three years that the roads at large have shown any very great interest in this question and too many of them are still sound asleep or dozing.

Helping the young men

A splendid movement has been started in the interests of the boys and young men in railroad service. On some roads unusual care is taken in selecting boys for positions in the various departments. On other roads little if any attention is given to this vital question. Even under the best conditions boys are often found in a department or on a class of work who by nature are much better fitted for some other type of work. Some boys cannot be happy or do their best work unless it is particularly adapted to their peculiar abilities. Something must be done to help these boys find the positions in which they can function to the best advantage. More than this, however, any boy can do much better work if he receives the right kind of coaching and encouragement. I am speaking now not of apprentice training, but of the more or less informal contacts with the boys. It is doubtful if any other single investment will mean so much to the railroads in the future as that which can be made by the foremen and supervisory officers, as well as by some of the men in the ranks, in showing a real interest in the boys' welfare and giving them a reasonable amount of encouragement.

The Transportation Department of the Y. M. C. A. held a boys' or younger men's conference in connection with its triennial conference at St. Louis two years ago. An attempt was made at this week-end meeting, which extended over three days, to give the boys some idea of the opportunities for life work on the railroads and to help them find themselves. Briefly, each boy filled out a form answering questions as to the kinds of work which appealed to him, what position he would like to hold ten years from now, etc. On the basis of these answers the boys were divided into small groups, each of which was assigned to the practical railway officer who could best talk matters over with the group and advise the individuals in it. I shall not take more time to explain just how the program was carried on, but it proved so successful that it was found necessary to hold a similar national meeting a year later at Detroit, and a third meeting of this kind is scheduled at Pittsburgh this fall. In addition, one system, the Chesapeake & Ohio, carried out a similar program for its own boys and special care is being given in following this up and getting the foremen and officers to take a larger interest in all of the boys on the system.

After all, the thing that counts in a movement of this sort is the actual concrete results. I know of no way in which these can be better expressed than through the boys themselves. Five months after the Younger Railroad Men's Conference at Detroit, I wrote to all of the boys, asking them if they had received any help or inspiration from the Detroit conference, and whether they had been able to pass this on to boys back home who were unable to attend the meeting. I want to read just a few typical extracts from the letters that I received in reply.

Before doing so, however, just a word about the Detroit conference.

Results of Detroit conference

The Detroit Younger Railroad Men's Conference was attended by 277 boys and young men and 51 leaders. Naturally, a certain percentage of the more ambitious and progressive boys went back home and started something. On the other hand, probably a large percentage of the boys personally profited greatly from the experiences at Detroit, but have not accomplished a great deal for their comrades back home, except that a change in attitude or conduct may have impressed itself upon those with whom they come most intimately in contact. Because the boys were carefully picked, undoubtedly the percentage of self-starters is fairly high.

Undoubtedly, also, the best results in specific communities have been obtained where the community was represented by several delegates. Where only one or two boys have come from a given point, it has been difficult for them to carry back and impress the spirit on their comrades, unless they are of unusual ability. Typical comments follow:

Car repairer apprentice, Boston & Albany.—"I would like to state that from the educational point of view, or in shops with some high employee of the railway company."

Machinist apprentice, Chicago, Rock Island & Pacific.—"Another value is to hear big railroad men talk—not only talk, but get acquainted with them. It's something that every boy and everybody doesn't get a chance to do. You also get acquainted with many railroads, railroads that you never hear about. First thing you'll ask, 'Where is this railroad and how big is it? And what are the apprentices doing?' You learn a lot of those things just from the boys sitting next to you at the dinner table, from the boys who are many miles from home attending the conference."

Machinist helper apprentice, Delaware, Lackawanna & Western.—"That conference has shown me what really great and many opportunities there are in the railroad game. It has encouraged me to study my daily work in the shops with greater interest. It has shown me that my employers are greatly interested in what the young men on our road are doing and that our employers are anxious to help us in our struggle to get ahead. Since the Detroit conference there have been greater activities among us apprentices at the Scranton shops of the Lackawanna."

Machinist apprentice, Lehigh Valley.—"First, it has shown me that the more we come in contact with the big business man, the more we take to him and understand

H. E. Warner (N. Y. C.)
President

C. A. Barnes (Belt Ry. Chi.)
1st Vice-president

F. M. A'Hearn (B. & L. E.)
2nd vice-president

Wm. Hall (C. & N. W.)
Secretary

fact from each and any point of view you may look at it, I personally have failed to find the words that will express the great value and helpfulness that I got out of it. It has shown me a different spirit towards my work and also towards my fellow workmen, also a cleaner and better way to live."

Machinist apprentice, Boston & Albany.—"Until the conference, things were sort of dead, but after the conference the fellows knowing the real meaning of service got to work. A greater interest was taken in our Christmas savings clubs. Americanization classes were started and a circulating library commenced. The officials hearing our reports soon understood that we were out to win and all sorts of help followed."

Clerk, Chesapeake & Ohio.—"Since the return of the other boys, we have gotten together and with the help of Mr. Watkins, our Y. M. C. A. secretary, we have organized a club known as 'The Ambitious Club.' The object of this club is to get the younger men and the employers in closer relationship. This club meets at the Y. M. C. A. every Monday night for about one hour and 15 minutes. The meetings are open and the business of the club is discussed. The rest of the time is spent listening to short talks and discussing questions arising in the office and him. Second, it seems as if the work comes easier to us if we have a better feeling toward our employer. One thing I have learned since I came back from Detroit, and which I think the conference was to blame for, and that is not to form an opinion of a person until you have heard some of his good deeds as well as his wrong ones. Because if you stop to think, none of us is perfect. It also proved that to co-operate is to secure benefits for both parties and creates a better feeling between both employee and employer. And that is to get everything out of it you can, especially to find out if you are in the right job. I think this was one of the most important questions asked. Because if you are not in the right job you are discontented and nothing seems to go right."

Sheet metal worker, New York Central.—"Possibly the most individual help was obtained through the Get-Together Meeting. Every young man was given the opportunity to discuss his problems with some older man who was well versed in that particular line of work. Such difficulties as: what a young man could make of himself with his own abilities, how a young man working at a trade which was not adapted to his standard of knowledge or abilities could become a better workman at some other branch of the service and at the same time serve his em-

ployer to a better advantage, were thoroughly reviewed and proved to be possible."

Clerk, Reading Company.—"When we returned home from the conference at Detroit, we decided that we should help the other fellows of our road. As a result of this decision we five who represented the Reading Company at the Detroit conference, organized a younger men's club on our road.

"The club is known as the Reading Company Younger Men's Club. It meets the first and third Friday of each month, in the Y. M. C. A. auditorium.

"The purposes of the organization are as follows: (a) To develop its members spiritually, mentally, physically and socially. (b) To foster and promote a spirit of unselfish service. (c) To assist young men in finding their proper vocation. (d) To promote good fellowship among the younger men of the Reading Company. (e) To promote a spirit of friendly co-operation between employer and employee."

Apprentice instructor.—"Personally, the Detroit conference was the biggest thing in my life and I see the railroad, my work and my boys and superior officers in an entirely different light than formerly. Railroading is no longer just a job, but the most important factor in the progress and development of our country. I do not know of a field that presents such a challenge or opportunity for service, improvement in methods, equipment, development and better human relationships."

Conclusion

I shall let these expressions speak for themselves.

Let us remember that the railroads are vital to the welfare and prosperity of the states and nation. If our foremen and supervisory officers are keen to take advantage of those things that will help them to improve their leadership ability and if we can select, train and inspire the new recruits so that they can find that work for which they are best adapted and in which they can be most happy, then we shall have gone a long way to safeguard the railroads of the future and the best interests of the communities which they serve.

Report on repairs to special appliances

When a booster engine is received at the shop, the engine is placed on a pit and the booster removed for overhauling. The booster binder is taken down and placed low enough to permit the axle gear to pass over, and the wheels to be run clear from the locomotive. After all wheels are removed, the locomotive frame is dropped down far enough to permit the removal of the booster engine by means of a specially constructed four wheel truck provided especially for this purpose. After the booster is removed, it is taken to the booster repair department, where it is placed on horses, at a convenient height for easy access to all parts, the booster resting on the engine bed and axle bearing, keeping the cylinder cock rigging free for testing.

The covers are then removed for washing, and the oil drained off. After it has been washed, each part is removed and inspected. The first part removed is the idler gear, rocker and pin. In most cases the gear bushing has been worn to such an extent as to cause lost motion in the gearing of the booster with the locomotive, and has to be replaced with a new bushing. If the gear is worn more than 10 per cent it is also replaced. It is seldom that a broken rocker is found.

The next part is the clutch cylinder. This is removed from the booster and given a thorough overhauling. Most of the trouble is found with the piston and rings; either, the piston sticks in the cylinder or the rings in the piston. These parts are washed thoroughly with kerosene, and made to move freely. When a clutch cylinder is removed a new gasket should be applied, as when the cylinder is assembled, to be in first-class condition, it must be air tight.

The air lines are then tested in the booster, after which an inspection is made of the pistons and valves. The back heads are taken off and the piston rings examined. In a great many cases it is found necessary to apply new rings.

The valves are then checked up to ascertain if any part of the valve gear is out of line. Sometimes, the valve rocker is found to be bent; in such cases, repairs are made. If everything is found satisfactory the heads are replaced and steam manifold inspected for cracks or steam leaks.

The cylinder jacket is looked over and repaired if necessary. To finish up the back end of the booster, the cylinder cock rigging is checked. In a great many cases the fingers are broken or too short, or the rigging out of line with the cocks, which makes it necessary to take the whole rigging apart for repairs.

When this work has been completed, the swab cups, the piston rods, the valve stems are repacked. An inspection is then made of the crossheads and guides. The crossheads are rebabbitted and machined, and guides are lined up to suit.

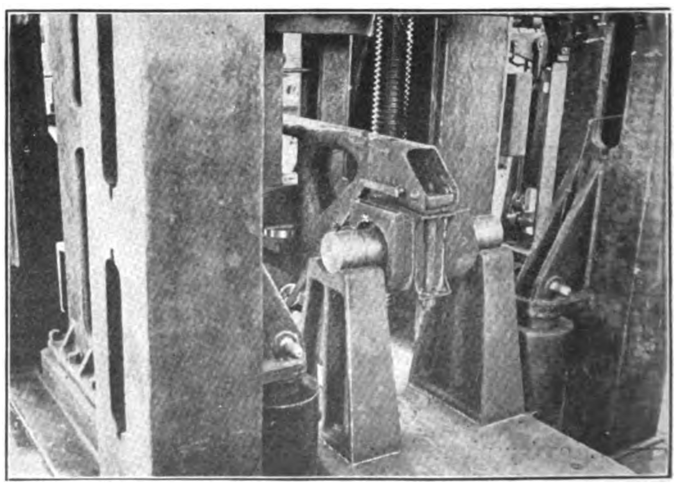
The next operation is the connecting rod bushings. This is a simple matter as these bushings are standard and are easily replaced.

The valve rocker bushing gives very little trouble. If found necessary to renew, it is babbitted and run in. The eccentric crank is next. If any lost motion is found there it must be replaced or a new crank pin is applied. In some cases both parts have to be replaced. The crank shaft and bearings are looked over and if the gear is found satisfactory, bearing caps are adjusted by means of liners being removed. If the gear is worn more than 10 per cent, it is replaced by a new crank shaft, likewise with all other gears in the booster.

When the covers and cylinder jacket are repaired and put back, the booster must be oil tight. The booster binder is replaced and axle bearings inspected. If no repairs are necessary, the booster is ready to be reapplied to locomotive.

The maintenance cost of boosters is low.

The report was signed by the chairman of the committee, R. D. Kocher, Delaware, Lackawanna & Western, Scranton, Pa.



Testing truck side frames at Lehigh University

Blacksmiths' Association Convention

FOLLOWING are abstracts of a number of papers and reports which were presented at the twenty-ninth annual convention of the International Railroad Master Blacksmiths' Association, held at Cleveland, Ohio, August 18-20, 1925. A report of this convention in which abstracts of a number of papers were also given appeared in the September, 1925, issue of the *Railway Mechanical Engineer*, page 575.

Drawbars and pins

By John P. Reid

Master blacksmith, Missouri Pacific, Kansas City, Mo.

All drawbars and safety bars are manufactured from hammered iron furnished from specifications drawn up in the office of the engineer of tests. The practice of closing the pin holes and shortening the draw bars has been discontinued on the Missouri Pacific. When a bar becomes worn in the pin holes, it is scrapped and manufactured into spring hangers or other parts.

We punch the pin holes on all drawbars used on our switching power and preheat when the bars are completed so as to remove all hammer strains that may have been set up during manufacturing. Too much care cannot be given the forging of draw bars. A "pull over" or "cold sheet" may be the cause of a heavy loss to the company. We drill the pin holes on all drawbars and safety bars on our heavy power, both freight and passenger, and preheat when completed which, I believe, goes a long way toward eliminating drawbar failures.

Since we have discontinued shortening, slabbing and closing the pin holes and replacing with new bars, a drawbar failure is a very rare thing. We are eliminating the offset drawbar. We all know that offset drawbars do not give the forging a fair trial. The offset is liable to cause a separation in the structure that cannot be seen with the eye and a surface crack will appear in due course of time. The inspector may or may not see it and the ultimate result is a drawbar failure.

The new power being purchased by the railroads is heavier and the best hammered iron is none too good for drawbars. We also use double refined iron for drawbar pins which comes in dimension lengths. The pins are headed and pointed and punched for a split key on a forging machine. We are not allowed to upset any pins to take care of worn parts. We replace with new pins and use old pins for other repair purposes such as boiler lugs, braces, etc. We do not allow any quenching of drawbars or pins at any time. This is a dangerous practice.

Reclamation

By Frank Laukat

Blacksmith foreman, Oregon, Washington Railroad & Navigation Company, Portland, Ore.

We know that tire steel makes good shear blades, reamer extensions and forging machine dies, and through the co-operation of the tool room foreman it can be used extensively with good results, with the exception of handle punches and side sets. When one considers the cost of making the latter and the danger in using them when made of tire steel, I feel that it will not take any one long to disapprove of such a practice.

We make piston nuts from scrap steel hollow locomotive axles by drawing them down to a hex bar about 8 in. long, letting the hole close as it will and then annealing. The bar is then taken to the machine shop where it is sawed up to proper lengths and the nut is ready for drilling and threading. We also make dry pipe sleeves and flue sheet rings from hollow axles by cutting them up at the cold saw to proper lengths and then drifting them out on the hammer. The steel in these axles is good and we have no trouble in drifting them.

All piston rods are made from scrap steel car axles. Taylor iron locomotive axles are usually saved for drawbars, and I do not know of any material on hand at the railroad shops today that is more suitable for that purpose.

Heat treatment of steel and iron

By Frank Sillix

Master blacksmith, St. Louis-San Francisco, Springfield, Mo.

The first step in annealing always consists in heating the metal past its critical temperature, because by so doing the existing structure, however coarse, is destroyed. Should the temperature of the steel remain below its critical range, no structural change would take place and the annealing would not be effective, except in cases where it is simply desired to remove strains produced by cold working. Strains can be removed in this case by heating to slightly below the critical range. This, however, has no effect on the grain size. On the contrary, should the temperature of the metal be carried considerably above its critical range, the structure of the metal, which was finest within the critical range, begins to coarsen on further heating and continues to grow as the metal cools slowly back to the critical range, so that a coarse structure is the final result. In order to anneal steel properly, it must be heated through its critical range and kept at a temperature as close to the upper part of that range as possible. The annealing temperature will vary with the carbon content, so the greater the carbon content of a steel, the lower will be its critical temperature.

The temperature at which these structural changes occur in steel is not absolutely fixed for any given carbon content, on account of the fact that this temperature depends somewhat on the rate of heating. It follows that there is a range of temperature in which these effects take place, rather than one single temperature. The words "critical range" are used to express the temperature range within which the structural changes outlined above take place.

The following ranges of temperature are recommended by the American Society for Testing Materials:

Range of carbon content, per cent	Range of annealing temperature, deg. F.
Less than 0.12	1610 to 1700
0.12 to 0.29	1540 to 1600
0.30 to 0.49	1500 to 1545
0.50 to 1.00	1455 to 1500

The locomotive forgings which we receive for rods, crank pins, driving axles, etc., and the billets received for the same purpose, have a carbon content of from 0.52 to 1.38 per cent, usually nearer the upper figure. An annealing temperature of 1,490 deg. F. to 1,530 deg. F. would, therefore, be correct for this class of work. Steel castings require a somewhat higher annealing temperature than forgings as the structure of a casting is more difficult to break up. The steel castings which we receive contain about .30 per cent carbon and should be annealed at about 1,650 deg. F.

The steel should be kept long enough at the annealing

temperature to be heated entirely through to that temperature. An exposure of 45 min. for each inch of thickness of the heaviest portion of the forging is recommended. For steel castings, an exposure of 60 min. per inch of thickness is desirable to secure thorough refining of the grain.

The hardness and strength of the steel depends upon the rate of cooling from the annealing temperature. Rapid cooling, as by quenching in oil or water, gives a hard metal which is somewhat brittle. Slow cooling, as in the furnace, gives the maximum softness and ductility at the sacrifice of a certain amount of strength and elasticity. Cooling in air gives properties between the two extremes.

The lower the carbon content, the more quickly may the steel be cooled without affecting too deeply the ductility and hardness of the metal. For instance, steel containing not over .15 per cent carbon may be quenched in water and still remain soft and ductile, while a medium carbon steel forging, say from 38 per cent to 52 per cent carbon must be cooled in air or in the furnace, for if quenched it would be too hard and brittle.

Since large objects cool more slowly than smaller ones under the same conditions, it is evident that the conditions of cooling should also be regulated in accordance with the size of the object. If a large and a small piece of steel of the same carbon content were heated to annealing temperature and then removed from the furnace and cooled in air, the smaller piece will be the harder of the two, since it will have cooled more rapidly. Locomotive forgings of fairly large size, such as rods, piston rods, and large crank pins, should be cooled in air rather than in the furnace, as this will produce a somewhat stronger steel, while, on account of their size, they will not cool rapidly enough to make the steel hard.

If the steel is heated above its critical range while in the annealing furnace, the grains grow in size and the steel is thereby weakened. If the steel is heated to several hundred degrees higher than its critical range, the grains grow to a very large size, producing a very weak and brittle metal, which may break when subjected to a slight shock. Since the growth of the grains takes an appreciable time, it follows that the longer the steel is held at a temperature above the critical range, the larger will the grains become.

Steel which has been overheated in the annealing furnace has a structure very much like that of a steel casting as removed from the mould, being weak and brittle. The overheated steel can be restored by allowing the steel to cool to room temperature, and then reheating to the proper annealing temperature, holding it at this temperature for sufficient time to permit the coarse structure to be completely destroyed, and then cooling as usual. If the steel has not been burnt, this treatment will completely restore it.

From what has been said above regarding the influence of temperature on the properties of steel, it will be evident that accurate means of measuring the temperature of the work in the furnace are absolutely necessary for proper annealing. This measurement of temperature can only be done by suitable pyrometers, which should be frequently checked for accuracy of reading. Most pyrometer installations in annealing furnaces indicate the temperature of the furnace and not the temperature of the work. These two temperatures are not necessarily the same, since the work lags behind the furnace both on heating and cooling.

It goes without saying that the heating of the steel must be as nearly uniform as possible, as otherwise there will be differences in the structure of the same piece and the possibility of strains being set up. The same applies to the cooling from annealing temperature.

Steel forgings of medium carbon should be annealed in all cases after forging, bending either hot or cold, or after any form of cold working. They should also be annealed at intervals during use, especially if they are subjected to heavy working stresses, as annealing removes the effects of fatigue. Annealing should also be given to all medium carbon steel parts which have been built up or otherwise repaired by any form of welding, as well as those cut by means of the oxyacetylene torch. The intense localized heat of welding or gas cutting produces a strained condition in the metal adjoining the weld or cut which is very likely to result in cracks if not removed by annealing.

In annealing, iron should be heated to about 1,250 deg. F. just so it will relieve the stress on the iron if there is any present.

Discussion

The importance of proper heat treatment of iron and steel in the railroad blacksmith shop was emphasized by many of those present. The old haphazard method of hardening by quenching was generally condemned and it was agreed that the analysis of the steel should regulate the heat treatment. A much better job can be obtained if a part is annealed or normalized after it has been forged or hammered. Normalizing seems to get better results than quenching.

One of the speakers brought out the fact that placing cold billets in a hot furnace causes the outside portion to break away from the center. This is caused by the billet heating too rapidly so that the outside portion becomes hot while the inside is still cold. The rapid heating changes the content of the outside surface and in order to prevent this occuring, billets should be preheated before being placed in the furnace. Some blacksmith shops make it a practice to heat billets over night. In such instances, the billets are placed in a cold furnace and it is then brought up to the critical temperature. All furnaces should be equipped with pyrometers.

Pieces eight inches in diameter should be heated ten hours, plus four hours. The four hours is required for heating and the ten hours for normalizing.

Frame making and repairing

By William Banks
Master blacksmith, Yazoo & Mississippi Valley, Vicksburg, Miss.

Frame making is practically a thing of the past at our shops, as all new frames applied at the present time on locomotives are of cast steel. We have not made frames in the blacksmith shop for several years and, I believe, about all of the other railroads are doing likewise. But, for the benefit of those that are still making frames in the smith shop, I will endeavor to explain the method we used in making locomotive frames.

We slab scrap iron axles which are heated in an oil furnace. After these axles are slabbed in billets from sizes six inches to eight inches square, the billets are heated in a furnace and the pedestal jaws, both top and lower, are blocked into sizes suitable for the frame. After this operation, the front and back pedestals are welded to the top and lower rails. These welds are made in the forge, after which these sections are welded together between the pedestal jaws which completes the frame. It is essential to keep the frame straight at each weld made and also to expand the lower rail after the last weld is made so as to avoid undue strains which originate from contraction. When new sections are required they are welded on in the smith shop. Also all frames that have been welded by the autogenous process are then taken

down, the welds removed and new sections are welded in at the smith shop. This only applies to locomotives that are in for general or classified repairs.

In regard to repairing frames, we use both the acetylene and electric process and have experienced very good results. But we all know it depends on the operator as to the kind of a job we get. If a frame is not welded properly in the smith shop, it will not hold up.

Tools and formers

By S. J. Uren

Blacksmith foreman, Southern Pacific, Sacramento, Cal.

Tools and formers are a necessity and no blacksmith shop can get along very well without them. If you have a steam hammer, hydraulic forge press, forging machine, bulldozer, air bending machine, or even an anvil in your shop, what good are they to you unless you have tools and formers. In this connection I will describe some of the tools and formers used in the forge shop of the Southern Pacific, Sacramento, Cal.

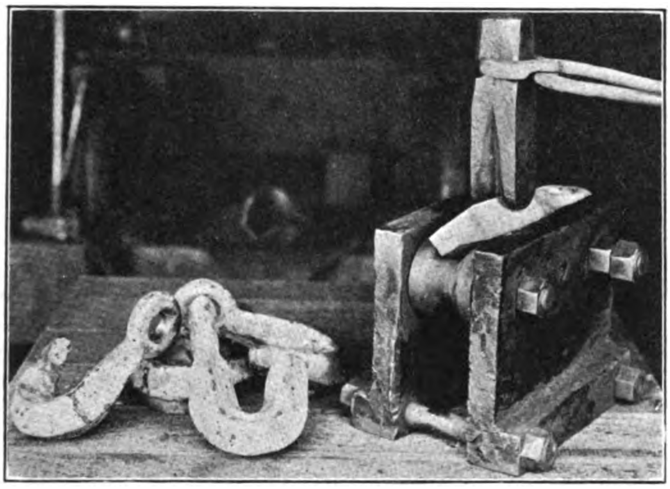


Fig. 1.—Formers for shaping wrecking chain hooks on a steam hammer

In making wrecking chain hooks, a piece of mild steel two inches square, is cut 11 in. long. The eye is formed in an eye forming tool placed on the steam hammer and the other end is slightly tapered. It is then heated the entire length and placed in the grooved rollers of the tool shown in Fig. 1. The top tool is then placed in the center as shown and a few blows of the steam hammer bend and press the piece down between the two grooved rollers and the hook is completed.

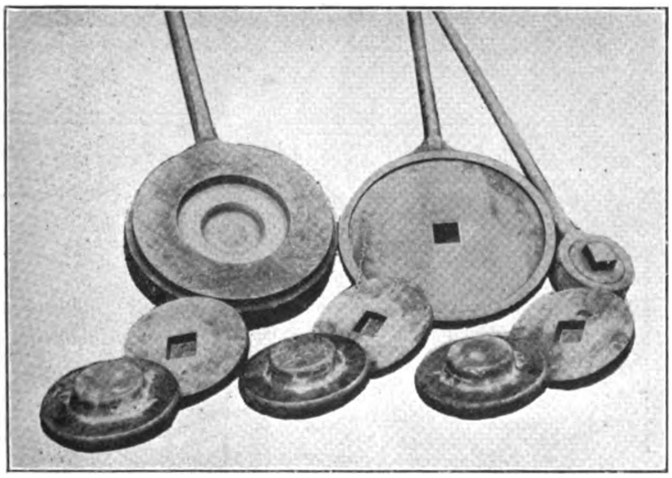


Fig. 2.—Dies for forming side rod collars

Side rod collars are made in a simple tool placed on the die of a forging press. A piece of four-inch mild steel is heated and placed in the tool. The ram on the forging press is then lowered on the material which easily presses it into shape in the tool shown in Fig. 2. The cap or gage is placed on top of the tool for the marking of the square hole in the center of the collar. The cap is then removed and a 1¾-in. square hole ⅞ in. deep is pressed in the collar which is then completed. This tool can also be used on the steam hammer to good advantage if you have no forging press in your shop, but the collars are pressed into shape much easier with a press than from blows of a steam hammer.

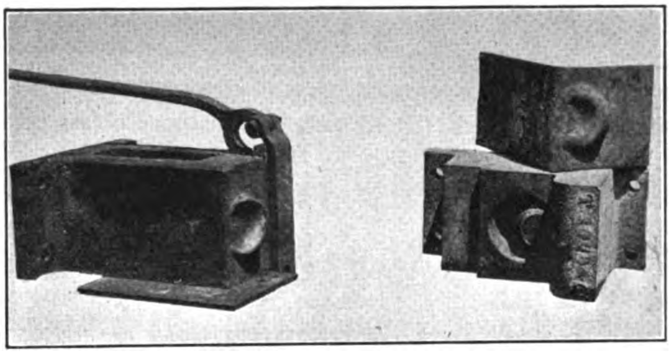


Fig. 3.—Bulldozer dies for manufacturing push pole corner irons

The bulldozer is a handy machine to have in a shop where there is a large quantity of bending and forming to be done, such as arch bars, drawbar yokes and pressing of sheet steel into various shapes that are now being used on modern freight cars. Push pole pockets for freight cars are easily made on a bulldozer with the dies shown in Fig. 3. The female former is bolted to the movable face of the machine and the male former is bolted to the stationary face. The material is then placed on a rest on the male former and held in place with a hinged clamp bolted to this former. The female former moves forward making the impression in the pocket and bending the material at right angles at the same time the impression is made.

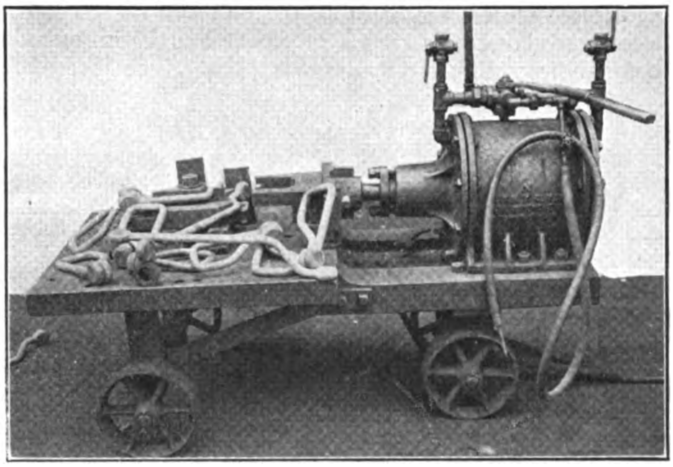


Fig. 4.—Former for offsetting and shaping brake hangers

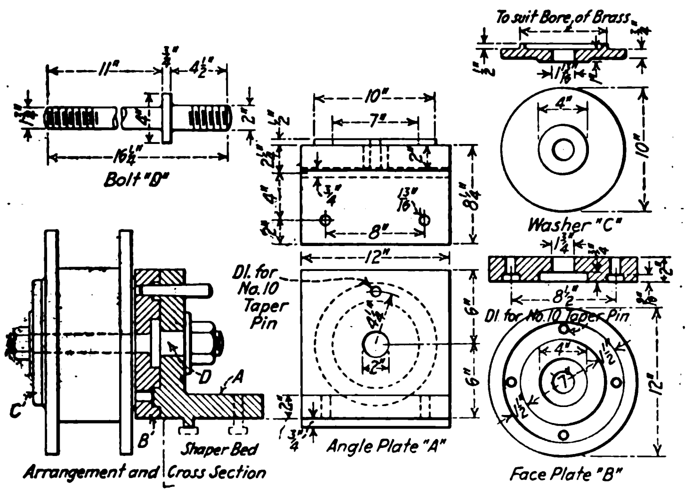
Brake hangers are easily bent to shape in formers attached to the small bending machine shown in Fig. 4. The ends of the brake hangers are first upset on a forg-

ing machine. They are then heated the entire length, placed in the lower part of the former on the bending machine, which is cut out to give the hanger the proper offset. The offset is pressed into shape and the material raised to the upper part of the former. The "U" shaped former which is attached to the piston comes up and bends the hanger to the proper shape on the stationary former which is bolted to the macine.

Jig for finishing rod brasses

By E. A. Miller

THE drawing shows a jig designed to be used on a shaper table when finishing the channels of driving boxes to fit the rods. It consists essentially of a cast iron angle plate with a rib to fit in the bolt slot of the table. The angle plate has a ring 7 in. inside and 10 in. outside diameter protruding from the side ½ in. The face plate *B* is made in the shape of a disc 12 in. in diameter and has a recess bored 9/16 in. deep in the face into which the protruding ring of the angle plate fits. This ring has four holes drilled as shown in the drawing and reamed for a No. 10 taper pin. One hole is drilled in the angle plate to permit the taper pin to be inserted through the angle plate into the face plate. Care must be taken when drilling and reaming the dowel pin holes to have all the holes in the ring fit square with the hole in the angle plate so that the pin will provide the same spacing for all four positions.



Jig used on a shaper table for machining the channels of rod brasses to fit the rods

Referring to the arrangement drawing, after the top side of the box has been finished, the dowel pin is removed, the box is rotated 90 deg. on the bolt *D* and the dowel pin is inserted again. After the side of the box has been finished to fit the rod, the pin is again removed and the box is rotated to position for machining the other side.

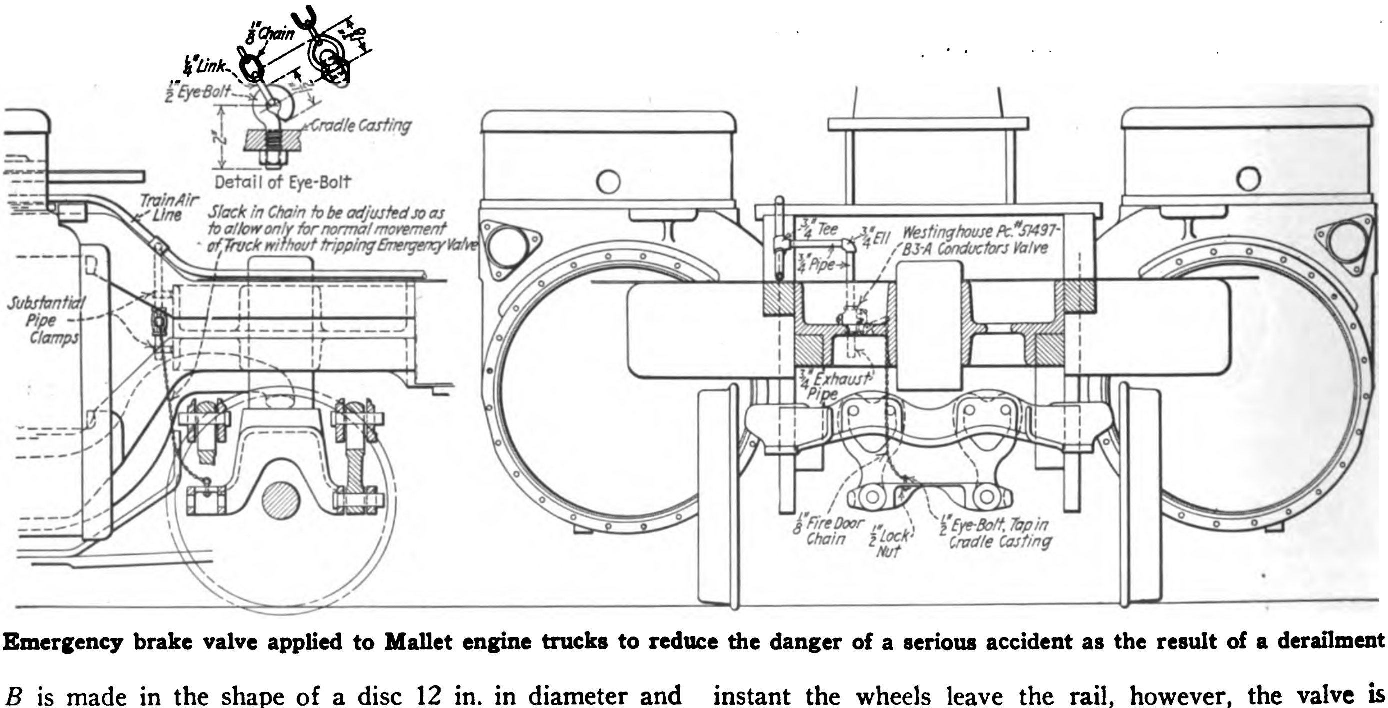
This type of jig, only of smaller construction, can also be used for front end brasses that have been made in halves and sweated together.

Emergency brake for Mallet engine trucks

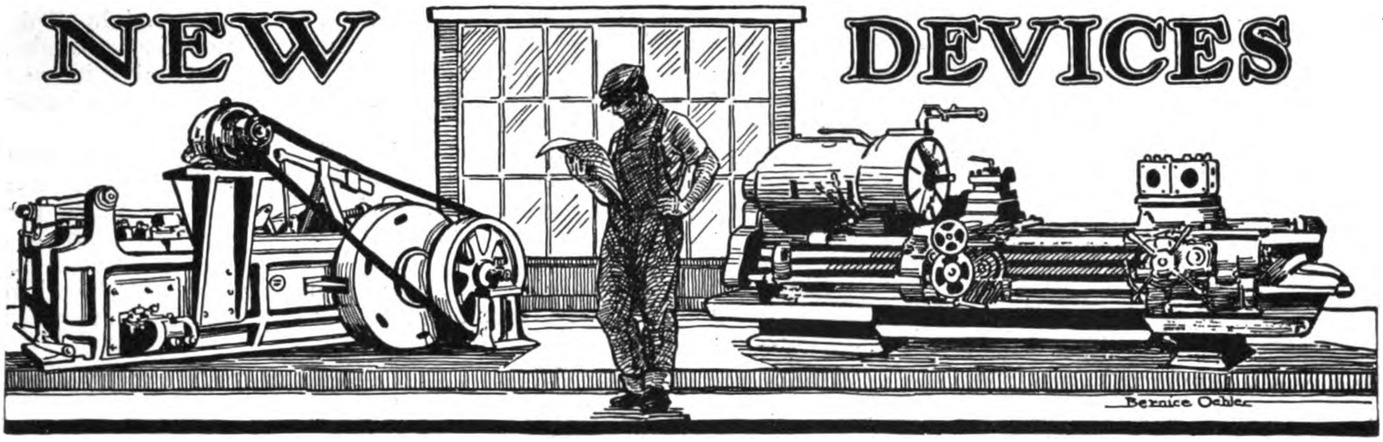
By H. C. Gillespie

Master mechanic, Chesapeake & Ohio, Huntington, W. Va.

IT is usually a difficult matter for an engineman running a Mallet type locomotive to detect the derailment of an engine truck. Sometimes when such derailments occur, the locomotive will be run for miles with the engine truck wheels on the ground unless they strike a cross-over or switch. When this happens, the entire locomotive is sometimes derailed with a possibility of a serious accident. In order to eliminate this danger, an emergency brake valve has been developed on the Chesapeake & Ohio which is to be applied to all Mallet locomotives. The operation of this emergency valve is simple. It consists essentially of a Westinghouse conductor's valve which is connected by a ⅛-in. fire-door chain to the engine truck rocker connecting link. The slack of the chain is adjusted to allow for normal movement of the truck without tripping the emergency valve. The instant the wheels leave the rail, however, the valve is pulled open by the chain which results in setting the brakes.

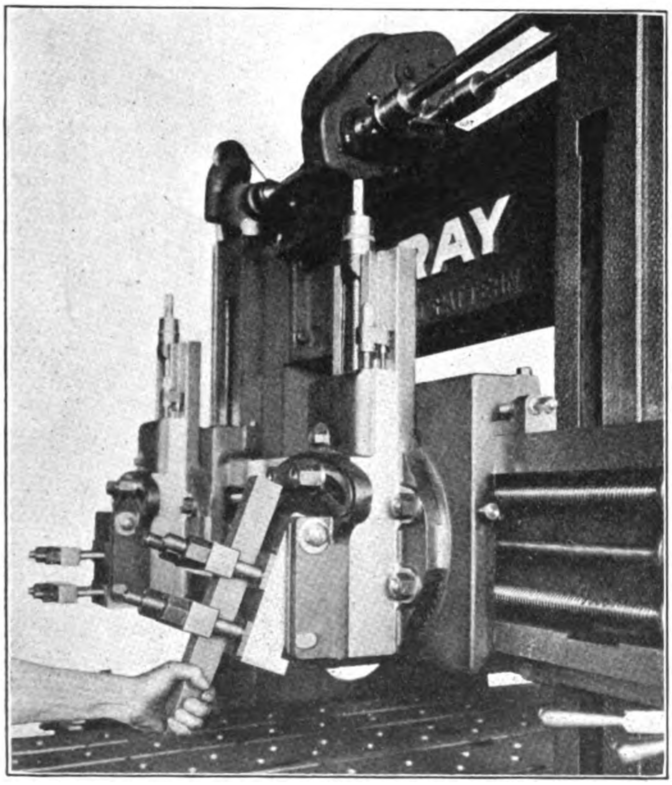


Emergency brake valve applied to Mallet engine trucks to reduce the danger of a serious accident as the result of a derailment



Openside planer with simplified control

AN openside planer built in 36-in., 42-in., 48-in., and 60-in. sizes has been recently placed on the market by the G. H. Gray Company, Cincinnati, Ohio. Recognizing the fact that openside planers are often used for very heavy work, and are therefore subjected to heavy cutting strains, the usual design of the column and knee has been departed from in order to make these parts heavy, and of unusually rigid proportions.



Head of the Gray planer showing the abutment apron and the twin-purpose taper gibs

This is evident from the fact that a 36-in. planer of this type has taken cuts with 3/16-in. feed, 1 in. deep in forged steel.

As the column is subjected to severe twisting strains it has been made triangular in section. Such a column is stiffer than the usual column of rectangular section because its walls are directly in line with the forces to be resisted, and there can be no yielding at the corners. A wide column face provides adequate support for the side head, even when long-reach tools are used. Heavy internal braces cast integral with the column add to its rigidity.

The bed of this machine not only has four vertical walls but is cast solid across the bottom under the gears and a heavy brace runs across the top of the bed directly under the cutting tools and the rail. This rigid structure eliminates vibration at this important point in the machine. The remainder of the bed is cast solid on top. The bed is planed on the bottom for ease of leveling and to relieve internal strains in the casting.

The heavy outer wall of the bed extends up on the side of the column to the level of the top of the table so as to support the column as high up and as near to the rail as possible. In addition a heavy tongue and groove, planed into the column and bed, with a metal-to-metal fit, fastens the column and bed together. No part of the bed or the drive mechanism extends below the floor-line, thereby making it possible to install the planer without providing special pits for the gear train or drive mechanism.

The gear train is similar to the helical gear train which has for years been a part of the Gray Maximum service planer. The gears and table rack are cut from steel forgings. They are helical throughout, including the bull gear and table rack, assuring the smoothness and the strength of the helical tooth.

A novel feature is the design of the bull gear which offsets the pressure of the tools on the work by exerting a side thrust on the table. The tools are usually fed away from the operator so that he can see the surface resulting from the cut, and the bull gear tends to push the table in the opposite direction. This materially decreases the tendency of the table to lift under a heavy cut. To still further reduce it, the bull gear teeth are designed with a nine degree pressure angle, so that the force exerted is very nearly horizontal, eliminating the usual vertical thrust. The Gray tooth form also provides a maximum of action in the arc of recess, rather than in the arc of approach, the teeth being of true involute form with long addendum pinions. The continuous rolling contact thus assured is not only of importance in getting fine finishing cuts but also ensures a steady flow of power for the heavy roughing cuts.

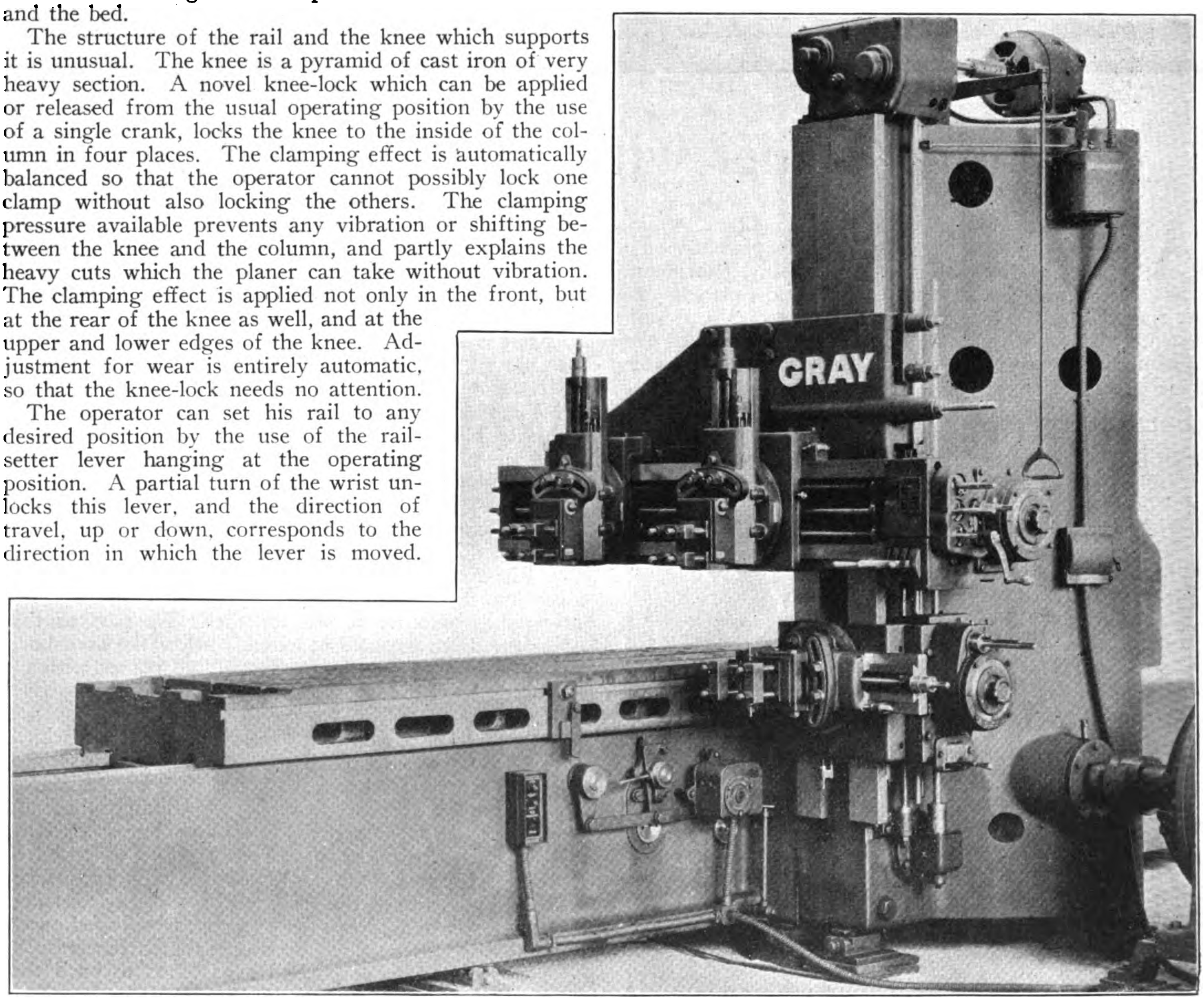
The gear train runs in a bath of filtered oil, and the side thrust bearings of bronze provided on each shaft in a flood of oil, as the upward pressure on the gib may, at bearings. This cascade of oil reduces the wear on the

driving train and cushions the teeth of the gear trains.

The necessity of planing overhanging castings of awkward proportions has induced the builder to provide hold-down gibs not merely at the center of the stroke, but over the entire length of the bed and table. Thus, tilting is prevented in any position of the table. The oil pumped to each V flows over the hold-down gibs, so that they run in a flood of oil, as the upward pressure on the gib may, at times, be almost as great as the downward pressure normally exerted on the vees. If it is necessary to remove the table, these gibs can be disengaged from the table without running it off the bull gear. Automatically oiled side thrust bearings are also provided between the table and the bed.

The structure of the rail and the knee which supports it is unusual. The knee is a pyramid of cast iron of very heavy section. A novel knee-lock which can be applied or released from the usual operating position by the use of a single crank, locks the knee to the inside of the column in four places. The clamping effect is automatically balanced so that the operator cannot possibly lock one clamp without also locking the others. The clamping pressure available prevents any vibration or shifting between the knee and the column, and partly explains the heavy cuts which the planer can take without vibration. The clamping effect is applied not only in the front, but at the rear of the knee as well, and at the upper and lower edges of the knee. Adjustment for wear is entirely automatic, so that the knee-lock needs no attention.

The operator can set his rail to any desired position by the use of the rail-setter lever hanging at the operating position. A partial turn of the wrist unlocks this lever, and the direction of travel, up or down, corresponds to the direction in which the lever is moved.



Front view of the Gray openside planer—all controls are centered in the right end of the rail, although a tumbler lever is provided on the other side of the bed for emergency use

As the rail does not drift when the lever is pushed into the "off" position, the operator can set it to a line and is encouraged to bring it down close to the work. This eliminates the tendency to take a long reach with the cutting tool, and enables the operator to take heavier cuts, and produce work free of chatter marks.

An entirely new device on this type of planer is the Gray ball bearing, spring counterbalance. A ball-bearing roller is mounted at the right hand end of the rail at the top. Heavy springs force this roller against the right hand edge of the column face, thereby keeping the rail and knee snug against the column even when unclamped. This counterbalance offsets the overhung weight of the knee, relieves the rail-elevating screw of binding strains, eliminates cocking and binding, and thus makes it easier to raise and lower the knee and rail, in spite of their massive proportions.

To set a head into place, the operator need only give one push to the rapid traverse lever. These levers are mounted in the right hand end of the rail, and this one motion of the lever suffices to start the motor in the right direction, disconnect the crank to avoid accident, and disconnect the feed mechanism. Putting the lever back into the "off" position automatically reconnects the power feed to the head and reconnects the manual crank. By this control the operator can quickly jump over an air gap in his job without "cutting air" for several strokes with the power feed. One rail head can be moved into place while the other is cutting, without interference. Similarly the slides can be moved up and down by rapid traverse. The Gray safety clutch disconnects the traverse motor and relieves the mechanism of all strains in case one head strikes another, or if the slide, in being moved downwards, goes too far, so that the tool strikes the bed of the table or the work.

The side head, when furnished, has its own rapid tra-

verse lever which is entirely independent from those provided on the rail. It also has its own feed dial.

On these planers the tool aprons are provided with an abutment or shoulder across the lower end. This prevents springing of the apron under the strain of clamping the tool. It bears against a corresponding surface on the lower end of the tool box, so that the upward thrust of the cutting tools comes on this abutment and not on the taper pin.

The table is of box-section, with heavy internal walls. One of these walls runs the full length of the table directly under the center T-slot, so as to tie the top and bottom plates together and prevent springing. This provision is supplemented by the double length bed; the table never overhangs, even at the extreme end of a stroke.

The "Cantslip" feed is a positive feed, not being transmitted through frictions. This ensures that the operator will get exactly the feed for which he has set the dial. The dial is self-locking, and is graduated in thousandths of an inch. A partial turn of the wrist automatically unlocks the dial and permits it to turn to any desired feed between zero and one inch, in steps of .01 in. The same type of feed is provided on the side head. A safety clutch instantly relieves the mechanism of strain should one head be allowed to feed into the end of the rail, or against the other head.

On this planer the oiling has been made as automatic as possible, not only by a continuous flow of oil to the V's, side thrust bearings, hold down gibs, gear train and shaft bearings, but by the provision of centralized oilers on the rail, rail heads, side head and column. The traverse motor requires no attention, as it runs on ball bearings in grease and drives the gears which run sealed in an oil case, mounted on ball bearings. It is recommended that the centralized oilers be filled once a week, a task that requires only five minutes. The oil under the gears, which passes through a filter, strainer and settling basin on each journey through the machine, need never be removed as it is automatically clarified and cleaned. The dirt taken out of the oiling system gathers in a pocket at the end of the bed, conveniently located for cleaning out.

The machines can be arranged for self-contained countershaft drive, motor drive with motor mounted directly on the column, or for reversing motor drive.

Wheel dog for changing journal brasses

In order to replace the bearing in a hot journal box some way must be found to hold the wheel firmly to the rail. The wheel is generally held down either by placing blocks or wedges between the top of the wheel and the bottom of the car, or by first jacking up the body and then forcing the wheel back down on the rail by means of a piece of timber used as a pry. This method requires an excessive amount of time and labor.

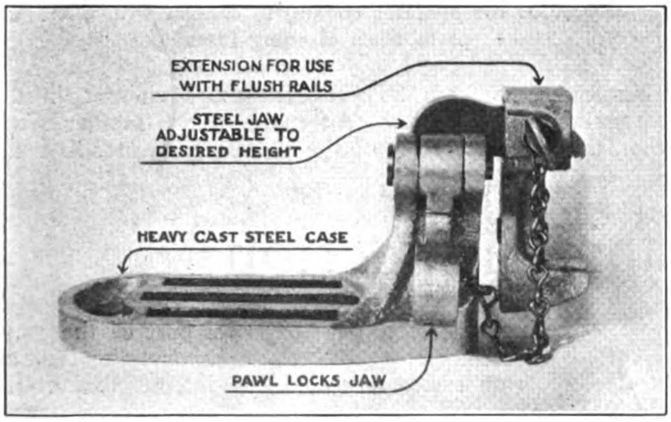


Fig. 1—Wheel dog with extension jaw in place ready for use when the rail is flush with the roadbed

The device shown in the illustration provides a means of effectively holding the wheel to the rail without the necessity of using any blocking whatever. It consists of a heavy steel base and upright to which is attached a drop forged steel jaw adjustable to any desired height and a pawl which locks the jaws in place after the load has been applied. An extension, which is used when the rail is flush with the roadbed is attached to the base by means of a small light chain so that it will not be lost.

Fig. 1 shows the device assembled to be used when the rail is flush with the surface of the roadbed. The end of the extension rests on the flange of the wheel. When the weight is removed from the brass by means of a jack which rests on the base of the wheel dog, the pressure exerted by the jack on the device prevents the wheel from leaving the rail. Thus, in a comparatively short time the weight is removed from the brass to permit its renewal without the necessity of securing blocking to keep the wheel to the rail.

Fig. 2 shows how the device is used when the rail is above the surface of the roadbed. The adjustable steel jaw grips the flange of the wheel and when the load is applied to the base of the device the wheel is firmly held to the rail.

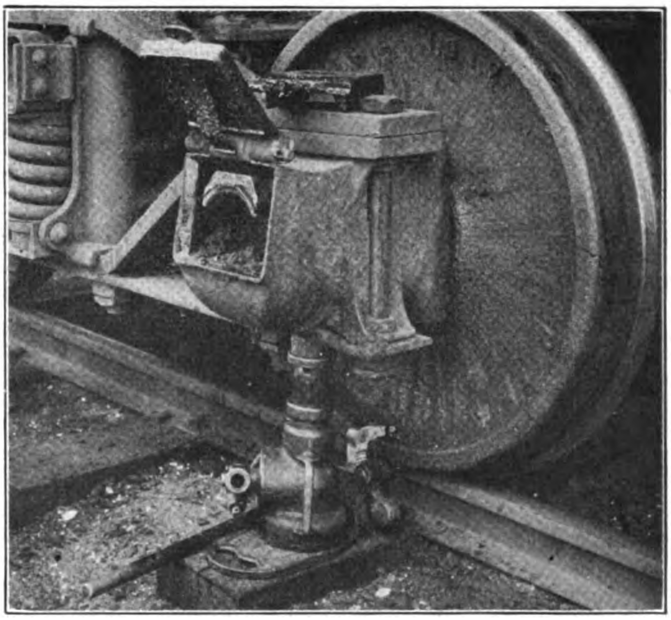


Fig. 2—Journal box jacked up off of the axle—The adjustable jaw has kept the wheel on the rail

This device can be used to advantage by car and locomotive tender repairmen and by train crews. It is manufactured by the Railroad Wheel Dog Company, Provident Building, Tacoma, Wash.

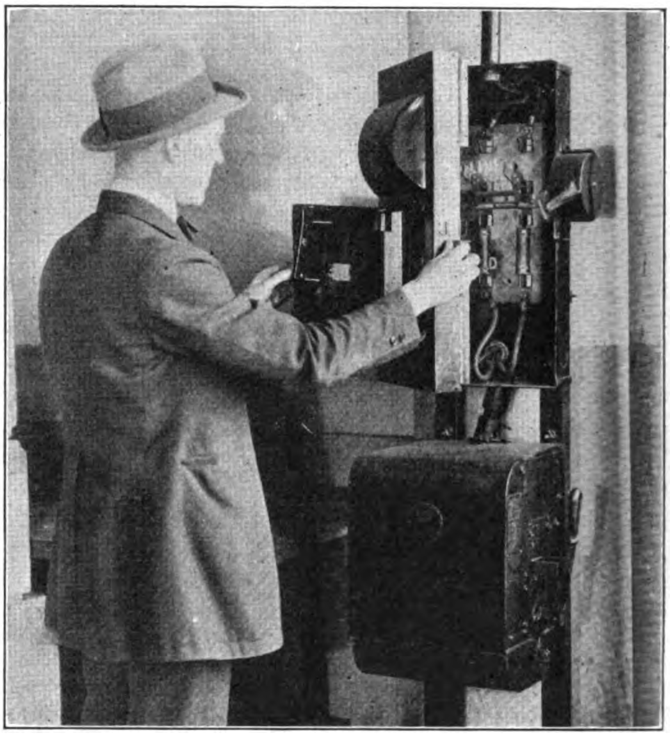
Safety switch which protects operator and motor

A SAFETY switch known as the WK-55 has been introduced by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., the design of which provides full safety for the operator and the motor under all conditions.

In order to eliminate the possibility of the operator coming in contact with live parts when changing fuses, the switch has been designed with a double door construction. Within the main door of the switch is a smaller door giving access to the fuse compartment. This fuse compartment door is interlocked with the operating handle in such a way that it will not open until the switch is thrown to the off position. In this position, even with the door open no live parts are accessible and as long as the door remains open the switch cannot be thrown on. The outer door covering the entire switch enclosure is designed for padlocking so that it can be opened only by an authorized person. This door can be opened for inspection and testing without interrupting the service.

The design of a new "make and break" mechanism, entirely contained in the operating handle outside of the cabinet, does away with the possibility of failure of the switch box to function properly, which would produce dangerous short circuit hazards. This design removes the danger of loose parts coming in contact with current carrying parts of the switch and leaves more space for wiring.

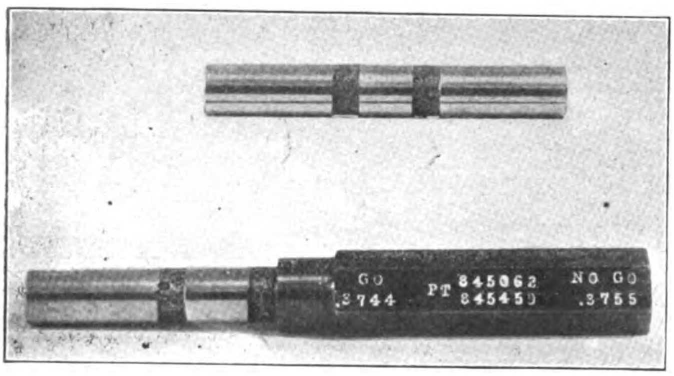
An arc quencher of simple design has been developed that serves to extinguish the arc quickly and efficiently when the circuit is opened. It consists of metal laminations, separated by layers of insulation and air space. As the blade traverses the quencher, the arc is broken into a series of sparks that are cooled by the metal plates and by the air currents between them. As the blade passes through the quencher, the arc is dissipated and cooled to such an extent that the current drops to zero and the circuit is interrupted without danger or damage. The arc quencher is capable of breaking circuits carrying from 50 per cent more current in the larger sizes to 300 per cent more in the smaller sizes, than the rated amperes of the switch, even at 500 volts.



Westinghouse safety switch provided with a double door to prevent the operator coming in contact with live parts when cleaning fuses

Plug gage for rapid inspection

THE present day tendencies among the railroads is to work to closer limits. This requires more careful inspection and the use of various types of gages. The plug gage is being used to advantage to keep the work within the allowable tolerance. A new type of plug gage has been placed on the market by the Van Keuren Company, Watertown, Mass., which is designed to permit of rapid inspection.



Plug gage designed to give maximum service

The gaging unit, which is the novel part of the gage, is shown in the upper part of the accompanying illustration. It has on each end a "go" gaging member of the desired length, usually about 1 in., and in the center is a "no go" gaging member about 3/8 in. long. As the "go" member is the one which enters the hole and is subject to the most wear, this gage provides a maximum of wearing surface.

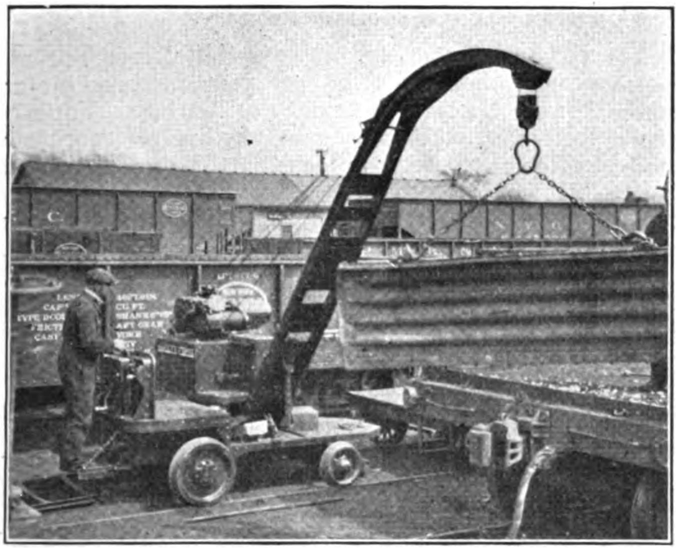
The plug gage unit is set in a handle as shown, being firmly cemented with stick shellac. The shellac protects the "go" member in the handle from corrosion, while the other end of the gage is being used. When one end is worn undersize, the gaging unit is reversed and thus a double life is secured. Sizes larger than 1/2 in. diameter may be used without a handle.

The gaging unit is made of a high grade tool steel selected for its wearing qualities and permanency. The steel is carefully hardened, thoroughly seasoned and the surfaces are lapped to a high finish.

These gages can be furnished to an accuracy of .00004 in., this accuracy being secured by light-wave measurement. Most plug gages have a wear allowance of about .0002 in. and the advantage of an accurate plug gage for tolerance work is that the gages may be kept close to the high limit.

A new tool for car repair work

Many portable electric cranes of the battery driven, four-wheel steering type built by The Elwell-Parker Electric Company, Cleveland, O., are used in locomotive repair shops, stores departments and engine houses. To satisfy a demand to extend the work of these units beyond the planked platforms and concrete runways, a new type is now offered the car repair department. This unit, running on standard gage track, will pick up deliveries at the shop or in the yard and deliver them alongside or actually place the piece on the car ready for bolting or riveting. It is serving as a dismantler of cars as well as an assembler and gathers scrap or waste material which it places on the pile or in the scrap car.



Portable electric track crane handling corrugated steel car ends

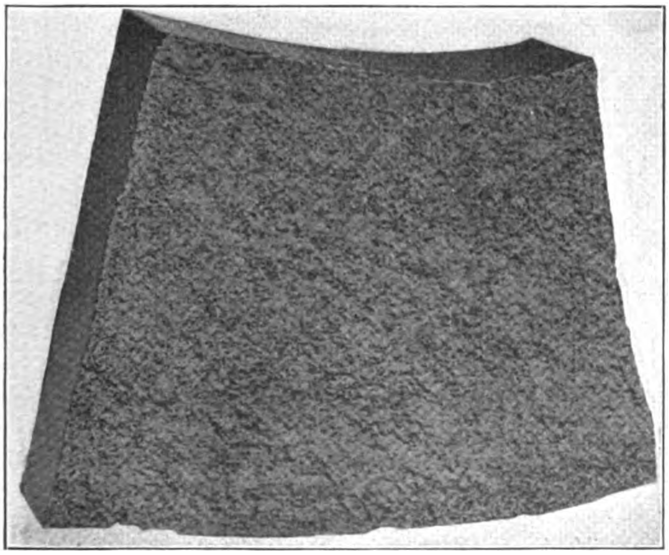
The crane consists of standardized units used on the floor type crane. Special heavy steel axles with good clearances beneath, fitting the standard gage rail track, are employed. The wheel base of the cranes is practically the same as most hand pushed cars and they use the same turntables as the latter.

The crane boom is of the telescopic type and of such length as to reach over the middle of a car on the adjacent track. The upper end of the boom is so curved that it clears the side of a gondola car 11 ft. above the rail. The operator retains his driving position on the tructor pedals when hoisting, raising or lowering the boom or when slewing it through 180 deg. from the right to the left track. All operations are by electric motor but the slewing may be effected by either hand or motor mechanism as specified.

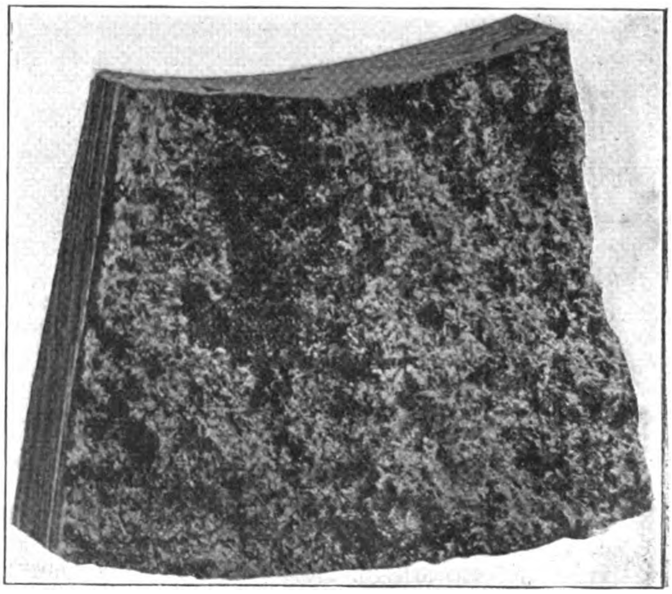
The outfit weighs approximately 7,000 lb. when fully equipped. It handles any load up to 3,000 lb. which brings within its range 90 per cent of the parts handled in car repair work. A crane on each third track serving cars on either side can do practically all the lifting and material handling, thus saving the use of the heavy locomotive type crane for work better suited to its capacity. The standard Elwell-Parker safety controls of power and brake are used throughout on this equipment.

Locomotive bronze crown bearings

When bronze crown bearings are cast in sand molds more or less trouble is experienced with sand in the surfaces which makes them difficult to machine, and with sand or blow holes in the body of the casting which cause many brasses to be thrown away before they have worn down to the wear limit. In an effort to overcome this difficulty, the More-Jones Brass & Metal Company, St. Louis, Mo., has adopted the practice of casting crown brasses in metal molds. This method is not entirely new but improvements have been developed by this company for which it has obtained patents.



Specimen of crown brass cast in a metal mold



Specimen of crown brass cast in a sand mold

An exhaustive comparative test has been made of bronze bearings cast in a chill and sand mold, the metal used being poured from the same pot. The results of these tests are shown below:

Chemical analysis

	Sand mold, per cent	Chill mold, per cent
Copper	72.70	72.55
Tin	7.10	7.15
Lead	18.80	18.95
Zinc and impurities	1.20	1.20
Phosphorus	.05	.05
Undetermined	.10	.10
	100.00	100.00
Brinnel hardness number	51	62
Tensile strength, 2 in. standard test bar	20,500 lb. per sq. in.	29,500 lb. per sq. in.
Elongation in 2 in., per cent	9.0	15.5
Elastic limit in compression (load necessary to produce a permanent deflection of .001 when applied to a 1-in. cube	11,800 lb. sq. in.	15.500 lb. sq. in.
Permanent deflection under load of 65,000 lb. per sq. in. when applied to a 1-in. cube	.28 in.	.16 in.

Transverse bending tests

Specimens 1 in. cross section; distance between supports, 10 in.; load applied at center.

Load, lb.	Vertical deflection, in. Sand mold	Chill mold
500	.013	.009
1,000	.035	.026
1,600	.063	.047
2,300	.340	.140
2,400	Specimen failed	.175
2,750		.300
3,200		.405
3,600		.520*

*Specimen started to fail.

The tests show that the pressure chilled cast bearings possess approximately a 50 per cent increase in the physical properties over the sand cast bearings. Furthermore, the chilled mold casting weighs five per cent more per cubic inch because of its density. The increased load factor and strength, due to the density of the pressure chilled cast bearing, are not the only real improvements; the pressure chilled cast bearings are free from sand, grit, oxidization and impurities.

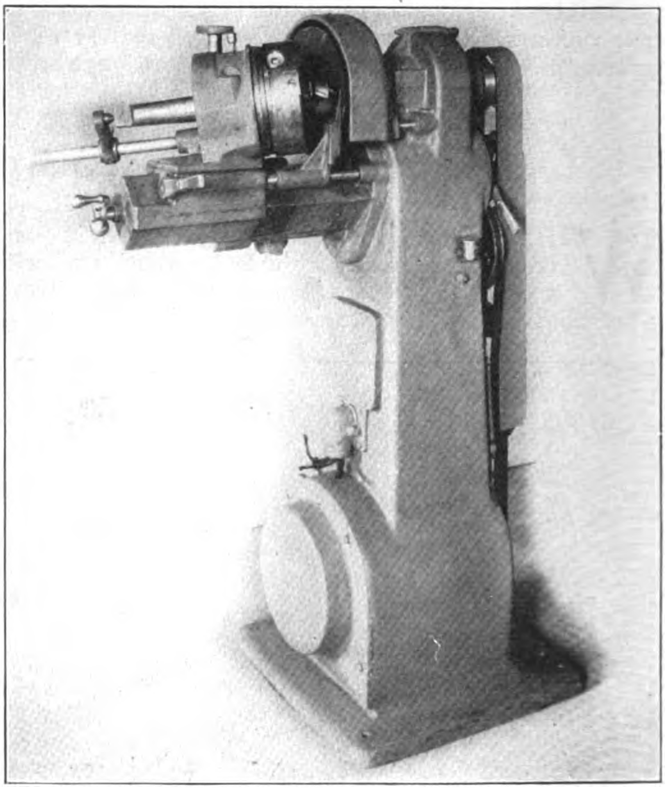
Oliver automatic drill pointer

THE efficiency of twist drills is largely dependent on proper grinding. If the clearance of a drill is insufficient or imperfect, it will not cut. When force is applied, it resists the power of the drilling machine and is crushed or split. It requires considerable skill on the part of a machinist to grind a drill so that the cutting edges have a proper and uniform angle with the longitudinal axis of the drill, having them of exactly equal length and the lips of the drill sufficiently backed off or cleared. In order to overcome this difficulty, the Oliver Instrument Company, Adrian, Mich., has had on the market for a number of years an automatic drill pointer designed to provide accuracy for this kind of work. The motions of grinding a drill are entirely automatic and are produced by fixed mechanisms. The drill is held in the machine in the same manner that it is held in a drill press. It is rotated automatically, stopping momentarily as each cutting lip is presented to the grinding wheel. The grinding wheel has two motions, one an oscillating motion which carries the wheel across the cutting edge of the drill; the other motion advancing the grinding wheel toward the drill as the drill revolves, the combined motions being such that a clearance is formed, the angle of which increases toward the center as is necessary for proper drilling. The operation of the machine depends in no way on the experience or skill of the operator. There are no adjustments on the machine and every type and size of drill is set exactly the same.

An improved design of this machine has recently been brought out. The grinding wheel on the old machine was carried in a rocker arm which oscillated across the point of the drill. It also had an end or axial motion which advanced the grinding wheel toward the drill as the drill revolved, producing the proper increase in clearance as the center of the chisel point of the drill was reached. Referring to the illustration, the new construction eliminates the rocker arm and the oscillating motion is obtained by the revolving of the wheel spindle in a quill, which has an eccentric motion. A cam operates the forward and backward motion of the quill, the same as in the old machine, but the new design has eliminated the universal shaft and joint.

Grinding is secured with a continuous fixed automatic multiple motion, producing a clearance, the angle of which increases toward the center as is necessary for proper drilling. The grinding wheel is thus given two motions in a manner similar to that described for the old machine. Both lips are ground with the same angle which insures the web being central, thus enabling bent drills to be ground accurately. Any practical combination of clearance angle, chisel point angle and drill point angle can be secured.

The chuck head is one of the new features which



An automatic drill pointer designed to produce a theoretically correct point

permits the holding of drills at the point instead of at the shank. The drill holding chuck can be perfectly centered or set for grinding off center as desired. This construction does not permit the changing of the point angle. Where this is desired, the manufacturers supply a chuck equipped with a universal head which holds

drills by the shank in a manner similar to the old machine. The new construction gives a continuous motion to the drill which increases the grinding speed about 50 per cent over that of the old type. The clearance cam being concentric with the wheel spindle eliminates possibility of lost motion between the cam and the drill.

A feature of the new machine is the elimination of the need of cooling water. There are two reasons for this. First, the direction of grinding tends to carry the heat away from the cutting edge of the drill. Second, the grinding of the drill while it is revolving presents each lip to the wheel momentarily, thus giving the heat a chance to be carried away from the edge while the next edge is coming in contact with the wheel. This permits the feeding of the drill as rapidly as the strength of the wheel will permit. It is claimed that with the addition of water, the speed of grinding could not be materially increased.

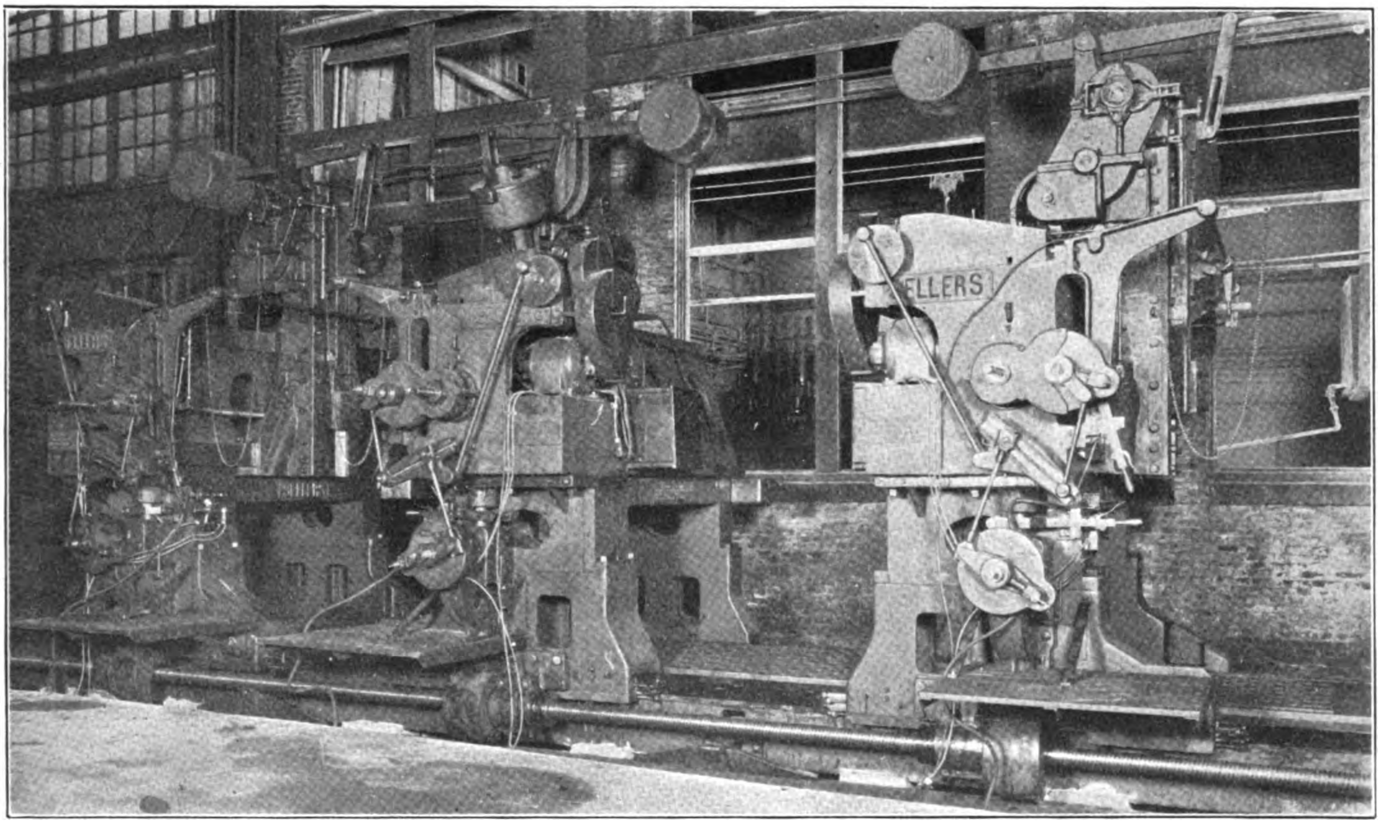
The Oliver automatic drill pointer is supplied in various sizes, one of which has a capacity up to 1½ in.; one a capacity up to 3 in., and a small type machine, a capacity from the smallest up to ½ in. and for two flute drills only. The larger machines are adjustable for either two, three or four flute drills.

Triple head locomotive frame slotter

A FRAME slotter has been designed and built by Wm. Sellers & Company, Inc., Philadelphia, Pa., to meet the requirements of constantly increasing sizes of locomotive side frames. While the machine is based on the best features of the smaller size Sellers frame slotters, it incorporates the advantages of the Sellers spiral pinion planer drive and improved reversing planer motor and control apparatus.

The machine consists of a heavy bed furnished with convenient bolt slots and supporting three slotting heads. The latter are moved by means of revolving nuts and a single screw extending along one side of the bed. They are guided by one upright with a relatively long bearing on the bed. The screw is stationary and therefore always kept in tension. As the bed is over 60 ft. long, the screw is provided with tumbler bearings which automatically move out of the way as the head approaches.

Each head consists of a substantial crossrail supported on two uprights or legs. The face of this crossrail is 3 ft. 10 in. from top to bottom and the depth of the rail is 3 ft. 5½ in. at the lower end and 2 ft. 5½ in. at the top. The uprights or legs of the cross head each have a bearing on the bed of 6 ft. 6 in. in length. The width of the main upright, which is used for guiding, is 16 in. and the width of the other is 10 in. The uprights are 5 ft. apart, giving ample dimensions on each side of the largest frame made. The height under the cross rail is 42 in. which is sufficient to allow four 9-in. frames to be slotted at one setting. The cross rail may be swivelled by a ratchet to 6 deg. on each side, allowing for the angular surfaces of the frames.



The Sellers triple head frame slotter

A saddle or slotting head of new design is mounted on each cross rail and provided with 5 ft. 3 in. of travel by means of a screw along the rail. Adjustable taper gibs are provided to take up the wear between the saddle and the rail.

Probably the most noteworthy feature of the slotting head is the method of driving the slotting bar. The

Sellers spiral pinion planer drive is used for this purpose. The driving shaft is actuated from the reversing motor through only two pairs of gears, one of which has herringbone teeth. Variations in the speed of the slotting bar are easily obtained by varying the motor speed with field rheostats. Cutting speeds of 25 to 50 ft. per min. are provided and return speeds of 50 to 75 ft. per minute. Speeds faster than these could be easily obtained, but are not found to be profitable when used with short strokes.

It is interesting to note that one difference between a crank driven slotter and a reversing motor driven slotter is that on the former the cutting speed varies from zero at each end to a maximum speed at the middle of each stroke, while the reversing motor driven slotter keeps the cutting speed constant throughout the stroke except for the acceleration at the start, and deceleration at the end.

The ram is made of steel and is of box section 8 in. by 15 in. outside dimensions. It is 6 ft. long so that there is always sufficient bearing in the guide to take the pressure of the cut and prevent deflection at either end of the stroke. A shoe, adjustable by set screws, is provided at the side of the ram to take up wear, and to help maintain alinement. The ram is counterweighted and provided with a forged steel rack 5 in. wide. The guide for the ram is 7 ft. 6 in. long.

Each head is provided with an electric feed mechanism. It gives the advantages of simplicity, easy adjustment and accurate timing. It is set to take the minimum amount of stroke to perform the feed. Feeds of 1/64 in. to ¼ in. are provided in small increments. At the end of each stroke the feed motor, which is connected to the feed discs, is started and runs until it has driven the discs 180 deg. when it stops. The starting and stopping of the feed motor is arranged through the master switch reversed by the ram, by means of a special limit switch. The feed motor is started at each end of the stroke of the ram and as it only requires a few seconds to move the disc, it is arranged to start just before the end of the stroke, and thus divide the time of operation between the two strokes. This reduces to a minimum the amount of stroke required for feed. Moving the feed discs operates the crank and ratchet from which both motions are set for the proper amount of feed.

The traverse of the saddles on the crossrail and of the crossrail on the bed are obtained with the same motor that is used for the feed. The push button control enables an operator to set his tool so closely that it is not necessary to use the hand adjustment. The latter is provided, however, in case it is desired. The speed of travel of the saddle and crossrail is 4½ ft. per minute.

The machine is equipped with several safety devices. The ram is provided with a mechanical knockout at each end of the stroke which disconnects the driving gear from the ram and instantly applies a brake. This protection is not necessary but is desirable in case the operator fails to set the stops properly or in case the stops become loose. There are limit switches at either end of the travel of the saddle on the cross rail which prevent traversing or feeding too far in either direction. The feed and traverse are interlocked so that the traverse cannot be started with the feed clutch engaged and vice versa. Furthermore, the tool ram cannot be operated while traversing, as it is considered dangerous to have the two operating at the same time.

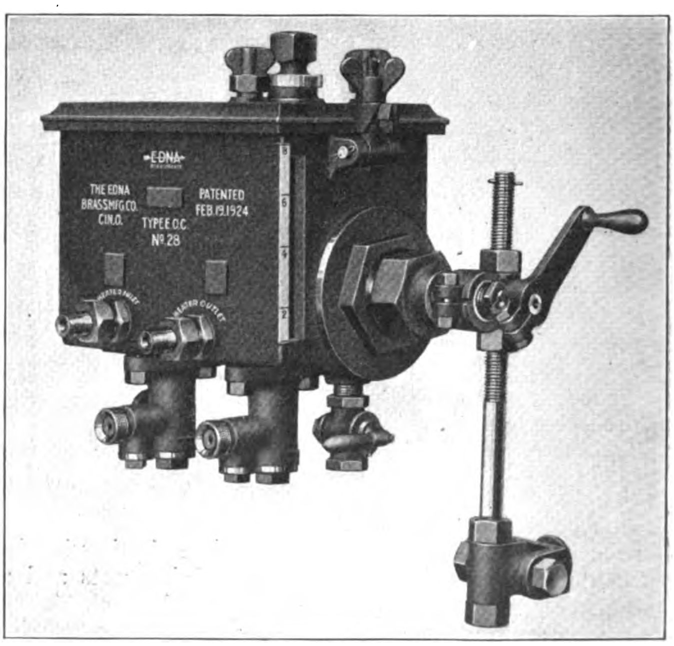
Locomotive force feed lubricator

A FORCED feed lubricator designed to meet railroad requirements has been placed on the market by the Edna Brass Manufacturing Company, Cincinnati, Ohio. It is made in five different sizes of two, three, four, five and six feeds with oil capacities of 8, 9, 10, 11 and 12 pints, respectively.

The body is equipped with sight glasses, one in each end, and a gage rod through the cover. Pint marks are stamped on the body. The lid is hinged. The lubricator can be used either right or left hand and to make the change requires only the reversing of the drive shaft and the lid. The drive is a fifty-tooth hardened steel ratchet and three pawls. The reverse ratchet is steel and is operated both by power from the locomotive and by hand. The forcing units consist of a hollow plunger and cylinder of steel, with brass and other metals suitable for their performance. The parts are immersed in oil at all times and require no attention. The discharge is made through the unit holder, equipped with two steel ball checks. The line check seat is steel hardened and ground. A second or intermediate ball check is used as added precaution against water leaking back to the lubricator.

In installing the lubricator, a suitable bracket ¾ in. thick should be provided with a length equal to that of the lubricator body and secured to a rigid part of the locomotive, preferably to studs in the back valve chamber head. Should conditions prevent, it can be placed elsewhere, but if it is not absolutely rigid, broken pipes may result. The terminal valves are provided with ½-in. standard pipe threads; these should be attached to tallow studs and can be set in any position.

The bodies of all the lubricators are equipped with heaters for a ⅜-in. steam pipe connection in which either live or exhaust steam can be used. If exhaust steam is



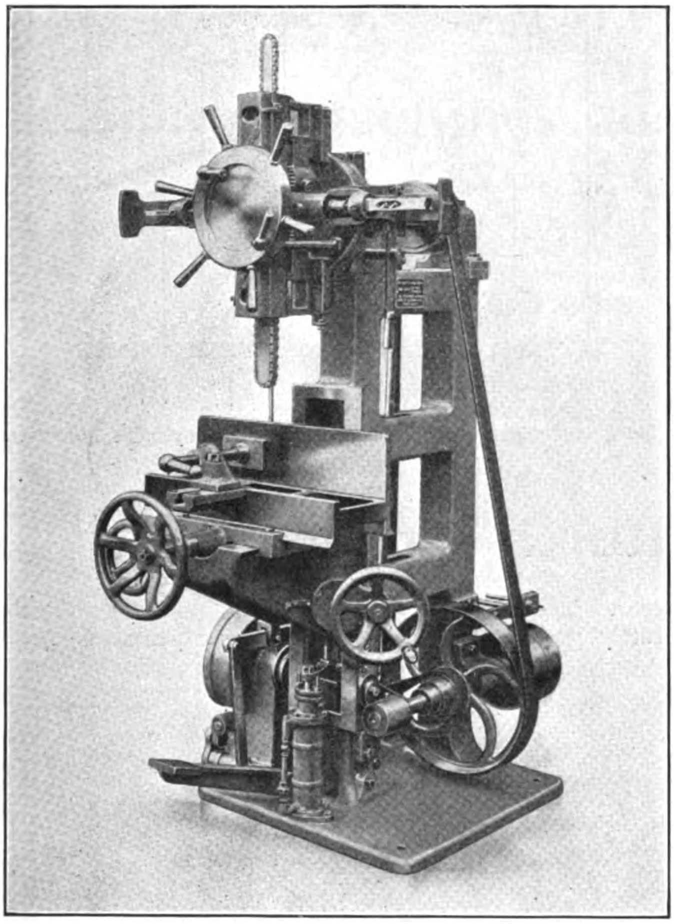
Force feed lubricator designed to prevent water from leaking back to the lubricator

used, it should be taken from the air pump exhaust. Precaution in piping must be taken to avoid water traps in

order to prevent freezing in cold weather. The terminal valves are set at 225 lb. pressure at the factory. This is sufficient in all cases where boiler pressure is lower than 210 lb; if a higher boiler pressure is carried, it will require the resetting of terminal valves to about 15 lb. higher than the boiler pressure.

Automatic chain and hollow chisel mortiser

In the past the chain and chisel mortisers manufactured by B. Smith & Son, Bingley, England, have been operated by hand levers. The drawback with these machines was principally with the chisel slide which could not produce a mortise hole larger than ⅝ in. square and to do this required a great amount of energy because it was necessary to broach a square hole as the boring augur did not bore a square hole. It had to be squared by the exertions of the operator. To overcome this undesirable feature, a full automatic chain and hollow chisel mortiser has been designed by the above manufacturer of machines of this type.



A square hole can be bored without any effort on the part of the operator

The body of the machine is in one piece and is of the open-column type which exposes every working part to the operator. The table has three positive ranges or travel to suit different size mortise holes. In the event of a chain breaking, there is a slipping clutch incorporated in the feed shaft mechanism which prevents any damage being done to either the tools or the machine. The table is fed up to the work by a rack and pinion. Mounted on the end of the pinion shaft is a large bronze work wheel and mounted directly underneath this wheel is a hardened worm running on the second gear shaft. This shaft is pivoted at its extreme end and on the operator pressing down the feed pedal this worm and shaft are raised into engagement with the large worm wheel and the table immediately begins to rise. On completion of the mortise, the operator simply releases the pedal which disengages the feed and the table descends rapidly but without shock or jar. The cushioning of the table on its return stroke is obtained through the action of a piston working inside a hydraulic cylinder.

A hand wheel is mounted on the right hand side of the saddle and by turning this wheel to the right the table is locked and held in any position after the foot has been removed from the feed treadle. This enables the slots to be cleaned out and when the table is required to descend, a quarter of a turn to the left of this hand wheel releases the table.

The drive is direct on to the main bottom shaft through the usual fast and loose pulleys and from this shaft a straight belt drives the top shaft upon which is mounted a friction clutch. This clutch is out of engagement when the table is at the bottom and in consequence the clutch spindle of the machine is stationary. When the operator presses down the foot pedal the table begins to ascend and a lever which is in engagement with the clutch and is held out of gear when the table at the bottom is then liberated, allowing the clutch spring to engage the loose portion of the clutch with the fixed, causing the clutch shaft to revolve. On completion of the mortise the table descends and on reaching the bottom, the clutch is automatically brought out of engagement, and the mortise chain cutter or hollow chisel comes to rest.

The turret mortise head is mounted upon a continuation of the top clutch shaft and carries four slides. There may be any combination of four different tools. As arranged, there is alternately a chisel slide and then a chain slide. Each of these slides carries either a complete attachment for driving a mortise chain or hollow chisel and they are mounted on ball bearings throughout. The end of the clutch shaft has mounted on it first, a straight spur wheel and then a bevel wheel. The spur wheel will engage with the chain slide and the bevel wheel with the hollow chisel slide. These slides are held out of engagement with a strong spring which is concealed within the slide, but upon the operator pulling the handle, which is mounted at the right of the machine, towards him, the turret is disengaged and can be revolved round in either direction. As each slide passes the bottom center, which is the working position, a fixed cam at the back of the turret engages with a roller fixed upon a stud and carried by each slide, causing the slide to be raised into gear with the wheel mounted upon the clutch slide, at the same time the turret automatically locks itself in this position and the cutting tool, whether chain or chisel, is in the correct cutting position. It will be clear from the above that only one tool is in engagement at one time and only this one is in rotation when the table is in motion. The turret can be swung round and any cutter brought into engagement without any risk to either the operator or the gears, because these are all stationary when the tools are being changed.

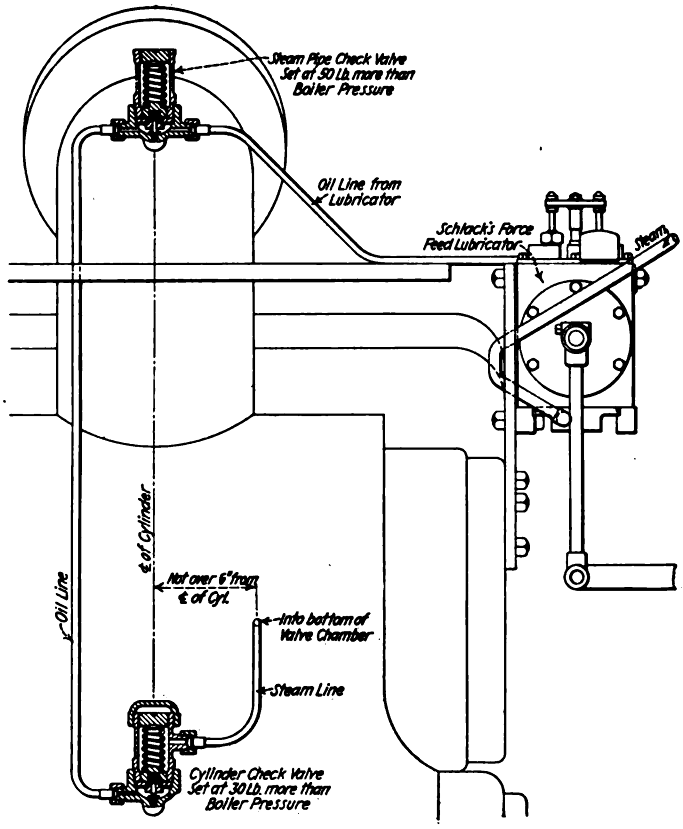
Schlack's force feed lubricator

With the system of alternate valve and cylinder lubrication for locomotives shown in the illustration, all of the oil is delivered into the steam pipe when the locomotive is working steam, but when the locomotive is drifting, all of the oil is delivered directly into the cylinders. In the alternate system there is a check valve in each cylinder in addition to a check valve in each steam pipe for each feed. The steam pipe check valve is set with a spring pressure to release at 300 lb. per sq. in. and has one oil inlet and two oil outlets. The cylinder check valve is set with a spring pressure to release at 250 lb. per sq. in. and has one oil inlet and one oil outlet and in addition has one steam inlet.

An oil pipe conveys the oil from the lubricator to the steam pipe check valve. Another oil pipe conveys the oil from the steam pipe check valve to the cylinder check valve. A steam pipe conveys the pressure from the pressure chamber of the main valve of the locomotive to the chamber on top of the diaphragm of the cylinder check valve.

When the locomotive is working steam, the steam pressure added to the spring pressure of 250 lb., the cylinder check valve holds the cylinder check valve spring to a higher oil pressure release than the steam pipe check valve with a spring pressure of 300 lb. The result is that all of the oil is injected into the steam pipe while the engine is working steam.

When the engine is drifting, the cylinder check valve is relieved of the steam pressure when the locomotive throttle is closed, so that it opens at the spring release pressure of 250 lb. This pressure being less than the spring release pressure of 300 lb. of the steam pipe check valve, all of the oil is injected directly into the cylinder. This lubricating system has been placed on the market by the United States Metallic Packing Company, Philadelphia, Pa.



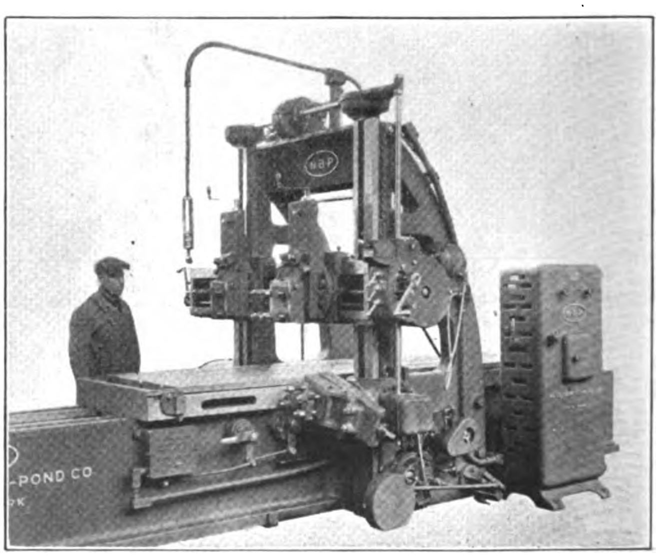
Piping arrangement for alternate valve and cylinder lubricator

Effective safety features for planers

An operator when setting up work on a planer often has part or all of his body between the work and the planer, and thus is in danger of injury by unintentional starting of the machine. Many planers afford absolutely no protection from this danger. A man may stumble against one of the control levers on either side of the bed, a passing truck may strike it, or it may be hooked by a swinging crane chain. A helper working around the machine and removing chips may move one of the control levers at any time, starting the planer suddenly and without warning.

It is possible to lock the control levers in the off position, but such locks are a source of danger, as they may become engaged while the planer is running. In this case some part of the reversing mechanism must break and the planer usually fails to reverse, running the table off the driving gear. Furthermore, it is well known that safety devices which require extra movements on the part of the operator are practically never used.

The master pendent switch, shown in the illustration, is designed to prevent such accidents. This is an important part of the electrical equipment furnished by the Niles-Bement-Pond Company, New York, on planers driven by direct connected reversing motors. A distinctive feature of this switch is that it may be used for instantly stopping the machine by pushing the handle upward. Operators make a practice of using it for this purpose because it can be reached more easily and quickly than the control lever. The planer cannot be started except by deliberately pulling down the handle of the pendent. Accidental starting is impossible and the operator is perfectly safe, no matter what happens to the control lever.



Location of the pendant switch in relation to the position of the operator

This switch may be used at any time without first throwing a distant transfer switch. Neither does the operator need to leave his position when resuming normal operation. The entire control of the table motion, starting, stopping, reversing or "jogging" by very small fractions of an inch is obtained by this switch. It is this feature which makes the master pendent so convenient and valuable as a safety device. The switch hangs by a flexible cable from a swivel on the arch or crosstie of the planer, permitting the operator to keep it in a location convenient to his working position. This makes it possible to stop the planer instantly in an emergecy, as the operator does not have to stoop and reach for the control lever, but simply hits the handle of the pendent.

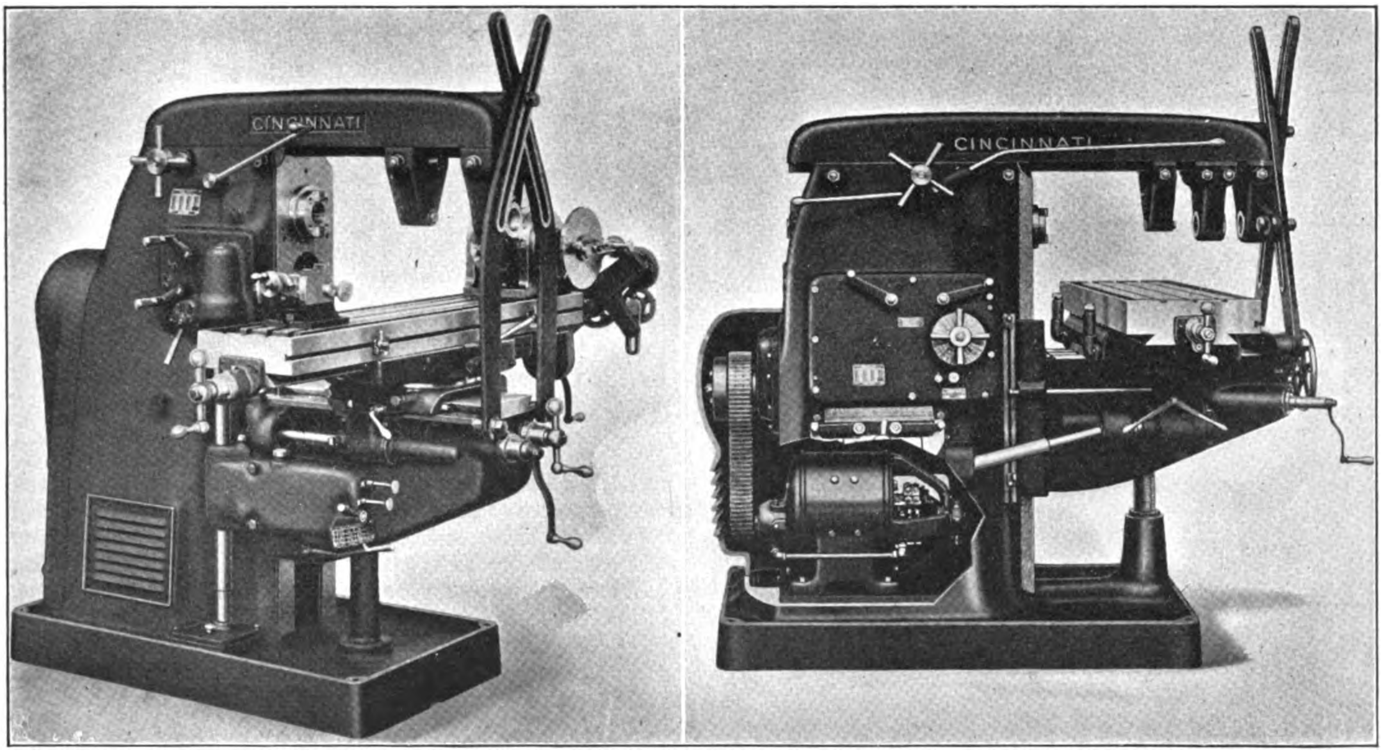
When starting a cut, the operator should take the pendent in one hand and the feed crank in the other. He can then feed in with confidence, as he can stop the machine instantly if the tool approaches a high spot on the work. Any lumps on the casting may be removed by a few short strokes, and considerable time is saved in starting the cut.

Another possible source of accident is failure of voltage. This occurs at times in every plant due to powerhouse trouble, blowing of fuses or opening of circuit breakers. As a result, the planer motor is left without a field and unless some means of stopping is provided, the planer will overtravel. Overtravel of a planer table is apt to cause serious damage, both to the work and to the machine, and is dangerous for the operator. Overtravel of planers having Niles-Bement-Pond controllers is prevented by the patented emergency brake winding and circuit breaker. If the voltage falls below a safe minimum, the breaker opens instantly and applies a powerful dynamic brake, stopping the planer at once. The special brake winding takes power from the armature when the breaker opens and is effective regardless of the reduction in line voltage. The circuit breaker prevents the planer from starting on return of the voltage, and also gives complete overload protection.

The crossrail elevating motor is also interlocked with the main driving motor, so that it can be run only when the planer is stopped. It may be controlled from either side of the bed or from the pendent switch, assuring the operator a good view of the work.

Milling machines adaptable for railroad shops

THE milling machines shown in the illustrations have recently been placed on the market by the Cincinnati Milling Machine Co., Cincinnati, Ohio. Both of these machines contain new features of design heretofore not a part of the older types of machines. The column is interchangeable for overhead belt or enclosed motor drive. The motor is bolted to a flat plate machined on both sides, which in turn is securely fastened to the box section base of the machine by heavy bolts. The drive from the motor to the shaft is by means



The left view shows the pyramid column M Type Universal milling machine—At the right is the No. 2 and No. 3 high power pyramid column milling machine with the column broken away showing the location of the motor

The most prominent change in design is the pyramid form column which tapers gradually in a straight line from the overarms to the rim of the base. The purpose of this design is to provide maximum strength and rigidity to the column, a proper foundation for heavy cutting and a space for an enclosed motor drive.

of a silent chain. Ample ventilation is secured through vents in the sides of the column and the rear cover of the motor compartment. Provision is made for easily and quickly oiling the motor and adjusting the brushes through the vent holes.

The speed mechanism of these machines are provided

with tapered roller bearings, which are new with these machines. Besides the two features already mentioned, the following are also common to both types of machines. Automatic oiling in the column; centralized oiling for the knee, saddle and table; power rapid traverse; sliding gear transmission; multiple disc clutch running in oil; double starting levers, and rectangular overarms.

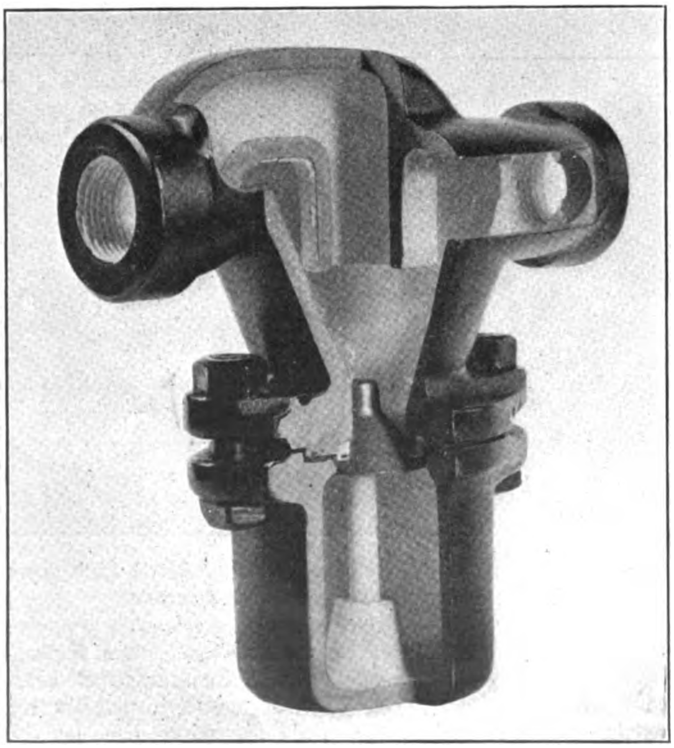
Careful consideration has been given in the arrangement of the levers so that the operator can control the machine from one position, thus eliminating any unnecessary movements about the machine. Double control levers have been provided so that the machines can be operated from either side.

The type M machine contains several refinements in design. A properly designed tapered gib connection to the column eliminates the necessity for clamping the knee, even when taking the heaviest cuts. A single piece vertical screw instead of the usual telescopic screw construction is employed. This arrangement lends itself in obtaining accurate and reliable dial readings. The saddle bearings for the table are as long as the full table travel. The wide knee bearing reduces the tipping tendency to a minimum.

There are certain fundamental differences between the M-type machine and the No. 2 and No. 3 machines. On the M-type machines the feed box is at the front of the knee, whereas on the No. 2 and No. 3 machines it is located at the side of the column. The power quick traverse is not supplied on the former type, whereas it is supplied on the latter.

Westinghouse centrifugal dirt collector

THE improved centrifugal dire collector recently developed by the Westinghouse Air Brake Company, Wilmerding, Pa., will contribute to economy and better maintenance of brake equipment. This



Centrifugal dirt collector containing a large dirt chamber and valve to prevent blow-back

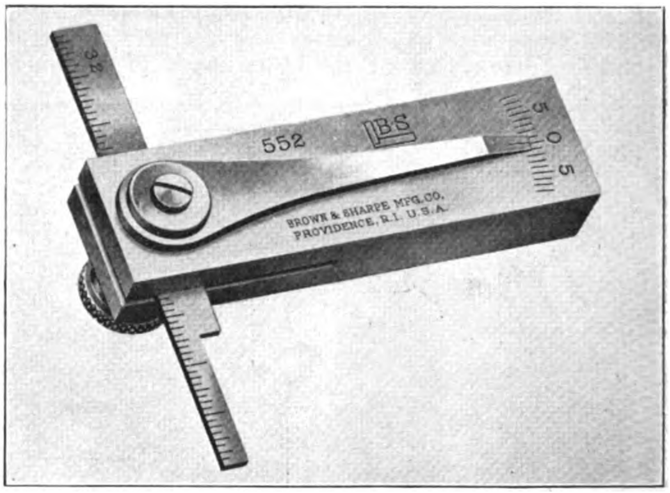
is due to the generous size of the chamber in which the dirt is deposited, its large capacity making it possible to accommodate all the dirt entering between cleaning periods. Moreover, cleaning is easily accomplished, it being necessary to remove but two bolts and drop the reservoir.

Another feature of the design is that obtained by the brass umbrella-shaped valve which floats on a stem in the lower chamber. Consequently, during charging of the equipment the swirling air currents impart a rocking motion to the valve which in turn deflects dirt particles into the chamber. The rapid reduction of the air pressure above the valve causes it to lift and seal on the seat, thereby isolating the dirt chamber so that no dirt can re-enter the brake system after once being collected. It is supplied both with and without drain cocks.

A diemaker's square

THE gage shown in the illustration is a handy tool for establishing clearances of drop forging dies and die castings. The pattern maker can also check drafts of patterns with it. This versatile gage is sold by the Brown & Sharpe Manufacturing Company, Providence, R. I.

It is easily set at any angle within its capacity by simply moving the pointer to the correct graduation mark



Brown & Sharpe diemaker's square

and tightening the knurled nut. The blade moves with the pointer. The graduations on the body read eight degrees on either side of the zero mark. Thus, the angle of clearance or draft setting is obtained by direct reading. A protractor is not required for setting this tool.

The blade is carefully graduated for 1 in. from either end—one side in 1/32 in., the other, in 1/64 in. The narrow end of the blade is 7/64 in. wide for small holes and the other end is 7/32 in. wide. The body is hardened and ground.

THE LAW OF NEW YORK requiring all locomotives to have side vestibule cabs, which has been before the courts for years, because of the refusal of the Public Service Commission to enforce it, has finally ben enullified by the Court of Appeals, which recently handed down a decision sustaining the commission in its ruling. The commission held that as the federal law covered the whole field of locomotive inspection, the state had no power to act. The firemen's brotherhood challenged the judgment of the commission and entered the suit to compel it to recognize the statute.

General News

The employees of the Paris (Ky.) shops of the Louisville & Nashville on July 31 completed a full year of work without a reportable injury to any employee.

The shops of the Delaware, Lackawanna & Western have been ordered to work only four days a week, the amount of car repair work having fallen off because of the strike in the anthracite mines. About 2,500 men are affected.

The Interstate Commerce Commission has denied a petition of the Chicago, Milwaukee & St. Paul for a suspension until further order of the second automatic train control order, entered January 14, 1924; but has granted another petition for an extension of time from July 1 to January 1, 1926, for the fulfilment by this road of the requirements of the first order (June 13, 1922). The commission has also postponed the effective date of the first order for the Chicago & North Western from July 1 to January 1, 1926.

Shop construction on the Chesapeake & Ohio

A contract has been awarded to Milo R. Hanke, Cincinnati, O., for the erection of a new boiler shop for the Chesapeake & Ohio at Huntington, W. Va. The building will be of steel and brick construction with a cement tile roof and a wood block floor, 140 ft. by 404 ft. It will have a boiler shop bay 90 ft. wide with a clear height of 40 ft. 6 in. and a machine bay 50 ft. wide with 37 ft. clear height. Two 15-ton electric traveling cranes will be installed in the machine bay and a 50-ton one in the boiler bay. The building will also have a number of 2-ton and 5-ton jib cranes. Modern machine tool equipment will be provided. The total cost of the project is estimated at $575,000.

Pennsylvania gives extensive automatic train control order

The Pennsylvania Railroad has given to the Union Switch & Signal Company a contract for automatic train control, the Union continuous induction system providing for the installation of the system on over 1,000 miles of road. Locomotives to the number of 1,000 will be equipped. This proposed work, complying with the Interstate Commerce Commission's general policy, will cost from six to seven millions of dollars.

Cost of fuel

The cost of fuel for road locomotives in freight and passenger train service (charged to operating expenses) for Class I steam roads for the first six months of 1925 was $163,120,525, according to the monthly report published by the Interstate Commerce Commission, as compared with $185,572,620 in the corresponding period of 1924. The average cost of coal per ton was $2.78, as compared with $3.18 last year, but the average cost of fuel oil increased from 2.73 cents a gallon to 3.17 cents. For the month of June the average cost of coal was $2.70 and the average cost of oil was 3.28 cents, making the total cost of coal and fuel oil for the month $24,376.103, as compared with $25,314,756 last June. For the six months' period the number of net tons of coal consumed was only 47,406,574, as compared with 49,721,957 last year.

Locomotives inspected

During August 6,604 locomotives were inspected by the Bureau of Locomotive Inspection of the Interstate Commerce Commission, according to its monthly report to the President on the condition of railroad equipment. Of these 2,689, or 40 per cent were found defective and 275 were ordered out of service. During the same month 121,328 freight cars were inspected, of which 3.3 per cent were found defective, and 2,421 passenger cars, of which 27 were found defective. During the month 17 cases, involving 32 violations of the safety appliance acts, were transmitted to various United States attorneys for prosecution.

N. Y. C. runs passenger engine without change between Harmon, N. Y., and Chicago

On Sunday, September 13, New York Central engine No. 3334 completed its first round trip from Harmon, N. Y., to Chicago and return without change en route. The locomotive left Harmon, the terminal of the electrified division out of New York City, Thursday afternoon, September 10, at 6:30 p. m., eastern standard time, on the Lake Shore Limited, arriving at Chicago September 11 at 4:00 p. m., central standard time, after a continuous operation of 946 miles in 22½ hrs. After a layover of approximately 24 hrs., this locomotive started the return trip on the Lake Shore Limited at 5:30 p. m. Saturday, September 12, completing the trip at Harmon the next day at 4:22 p. m. This constitutes a record for the New York Central which, however, already has increased the length of the locomotive runs on its through passenger trains so that the present practice is to change engines at Buffalo only, where formerly seven locomotives were required to complete the run between Harmon and Chicago.

New freight cars placed in service

A total of 83,291 freight cars was placed in service during the first six months of 1925 by Class I railroads, according to a statement issued by the Car Service Division of the A. R. A. This was an increase of 12,417 cars as compared with the number installed in the corresponding period of last year and an increase of 4,051 cars as compared with 1923. The total included 43,627 box cars, 29,504 coal cars and 3,382 refrigerator cars. There was, however, a substantial reduction in the number of new freight cars on order on July 1, to 28,197, as compared with 60,315 last year and 96,855 in 1923.

Class I railroads during the first half of 1925 also placed in service 927 steam locomotives, compared with 1,071 during the same period last year and 1,998 during the same period in 1923. The same roads on July 1, 1925, had 279 locomotives on order compared with 360 on the same day last year and 1,902 two years ago.

The figures as to cars and locomotives include new, rebuilt and leased equipment.

The average capacity of the freight cars owned by the Class I railroads on July 1 this year was 44.56 tons, as compared with 43.88 tons on the same date last year, or an increase of 1.5 per cent. The average tractive power per locomotive on July 1 this year was 40,215 pounds, as compared with 39,571 pounds on the same date last year, or an increase of 1.6 per cent.

Anniversary and celebration of Pitcairn car shop

The tenth thousand car was recently turned out of the steel car shop of the Pennsylvania at Pitcairn, Pa., and this event was celebrated by an old-fashioned anniversary and celebration, consisting of athletic contests, musical entertainments, dancing and band concerts. The Pitcairn car shop, established in 1890, consisted of a roundhouse for repairing freight cars, a small brick office building and four repair tracks. The present roundhouse in which repairs are made to freight and passenger cars and locomotive tenders, contains 42 repair tracks. The steel freight car repair shop, erected in 1923 at a cost of approximately $1,000,000, is equipped with all modern and labor-saving devices. The main building of this shop is 100 ft. wide and 620 ft. long, and the rivet cutting building, 35 ft. wide and 200 ft. long. Approximately 800 men are employed in the steel car shop and a car is rebuilt and turned out every 24 min. Passenger cars are given heavy running repairs, and there is also a progressive system for class repairs to 22 passenger cars per month, this being the only class repair shop in the Central region. About 4,000 freight cars are repaired on various repair tracks per month. Repairs also are made to locomotive and car air brake parts for all points on the Western Pennsylvania division. There is a machine shop, forge

shop, paint shop, cabinet shop, upholstering shop, tin shop, blacksmith shop and a large stores department which furnishes material for the entire shop.

Progress in train control installation

The work of installing automatic train control devices in accordance with the orders of the Interstate Commerce Commission, which will require the expenditure of approximately $26,000,000 by the 45 roads named in Order No. 1, is progressing rapidly, according to a statement issued by W. J. Harahan, chairman of the Committee on Automatic Train Control of the American Railway Association.

Up to August 1 this year, out of 7,745 miles of track of the 45 carriers designated for installation of train control devices, installation had either been completed or was under way on divisions totaling 5,044 miles, or 65 per cent of the total mileage covered by the order. On January 1, last, installation had been completed or was under way only on 3,592 miles, or 42 per cent.

All of the 45 roads have selected a train control device for installation. Three roads have selected the ramp type, 23 the intermittent induction type, 13 the continuous induction type, and 6 the plain automatic stop using continuous control.

Thirteen roads have completed permanent installation, while 16 roads have permanent installation now under construction. Preliminary installations have been completed by 13 roads, while 3 others have preliminary installations now under construction.

The original order of the commission named 49 roads, but the Chicago, St. Paul, Minneapolis & Omaha; the Buffalo, Rochester & Pittsburgh; the Western Maryland, and the Chicago & Erie were later exempted. The commission on January 14, 1924, in its order, No. 2, also ordered 47 of the roads listed originally to install train control devices on a second division, but later exempted five of those roads. The commission in its Order 2 also ordered 45 additional roads to equip one division prior to February 1, 1926. Later, at the request of the carriers, the commission also suspended the second order so far as the 45 additional roads were concerned.

The permanent installations completed or in service, according to reports of the roads to the Interstate Commerce Commission, are as follows:

Road	Location	Maker	Mileage
Atchison, Topeka & Santa Fe	Chillicothe, Ill., to Shopton, Ia.	Union	209
Chesapeake & Ohio	Gordonsville to Staunton, Va.	American	61
Chicago & Eastern Illinois	Chicago to Danville, Ill.	Miller	210.8
Chicago, Rock Island & Pacific	Blue Island to Rock Island, Ill.	Regan	330
Galveston, Harrisburg & San Antonio	Rosenberg to Gidden, Tex.	National	50.6
Missouri Pacific	Leeds, Mo., to Osawatomie, Kan.	National	49.9
New York, New Haven & Hartford	Air Line Jct., to Springfield, Mass.	General and Union	124
Norfolk & Western	Hagerstown to Shenandoah, Va.	Union	105.8
Oregon-Washington R. R. & Navigation Co.	Portland to The Dalles, Ore.	Union	86.5
Reading	Camden to Atlantic City, N. J.	Union	108.2
Southern Pacific	Oakland to Tracy, Calif.	National	98.8
St. Louis-San Francisco	Nichols to Monett, Mo.	National	44.4
Union Pacific	Sidney, Neb., to Cheyenne, Wyo.	Union	204

Permanent installations are under construction on the Atchison, Topeka & Santa Fe (second Order); Atlantic Coast Line; Baltimore & Ohio; Central of New Jersey; Chicago, Burlington & Quincy; Chicago & Northwestern; Chicago, Milwaukee & St. Paul; Cincinnati, New Orleans & Texas Pacific; Delaware, Lackawanna & Western; Great Northern; Illinois Central; Louisville & Nashville; Northern Pacific; Pennsylvania; Pere Marquette, and Southern.

Preliminary installations are in operation or have been completed by the Boston & Albany; Boston & Maine; Chicago & Alton; Chicago, Indianapolis & Louisville; Delaware & Hudson; Kansas City Southern; Lehigh Valley; Michigan Central; New York Central; New York, Chicago & St. Louis; Pennsylvania; Pittsburgh & Lake Erie, and Richmond, Fredericksburg & Potomac.

Preliminary installations are under construction on the Cleveland, Cincinnati, Chicago & St. Louis; Erie, and Long Island.

The three roads that have selected the ramp type are the Chesapeake & Ohio (American); Chicago & Eastern Illinois (Miller), and Chicago, Rock Island & Pacific (Regan).

The twenty-three that have selected the intermittent induction type are the Atlantic Coast Line; Boston & Albany; Cincinnati, New Orleans & Texas Pacific; Cleveland, Cincinnati, Chicago & St. Louis; Delaware & Hudson; Erie; Kansas City Southern; Lehigh Valley; Michigan Central; New York Central; Pere Marquette, and Southern, of the type of the General Railway Signal Company; the Chicago & Alton; Galveston, Harrisburg & San Antonio; Missouri Pacific; St. Louis-San Francisco, and Southern Pacific, of the type of the National Safety Appliance Company; the Chicago, Burlington & Quincy; Chicago, Indianapolis & Louisville; Great Northern, and Northern Pacific, of the type of the Sprague Safety Control and Signal Corporation; and the New York, Chicago & St. Louis, and the Pittsburgh & Lake Erie, of the type of the Union Switch & Signal Company.

The thirteen that have selected the continuous induction type are the Chicago & Northwestern and Baltimore & Ohio (General Railway Signal Company), and the Boston & Maine; Delaware, Lackawanna & Western; Long Island; Louisville & Nashville; Oregon-Washington Railroad & Navigation Company; Richmond, Fredericksburg & Potomac; Union Pacific; Atchison, Topeka & Santa Fe; Norfolk, Western, and Reading (Union Switch & Signal Company).

The six that have selected plain automatic stop are the Chicago, Milwaukee & St. Paul; Illinois Central; New York, New Haven & Hartford; Pennsylvania; Pittsburgh, Cincinnati, Chicago & St. Louis; and West Jersey & Seashore (Union Switch & Signal Company).

Meetings and Conventions

Steel Treaters convention at Cleveland

The seventh annual convention and exposition of the American Society for Steel Treating was held at Cleveland, Ohio, September 14 to 18 inclusive, and in attendance and in size of exhibition undoubtedly surpassed any convention yet held by the Society. While official attendance figures are not yet available it is understood that the total registration, including guests, was in the neigh-

Freight cars installed and retired

Month—1925	Installed during month	Aggregate capacity tons	Retired during month	Aggregate capacity tons	Owned at end of month	Aggregate capacity tons
January	11,768	551,263	7,867	326,812	2,341,109	103,812,974
February	15,024	721,867	9,453	365,111	2,346,687	104,169,525
March	16,007	753,947	12,067	474,644	2,350,697	104,454,128
April	13,749	652,462	10,497	423,322	2,353,956	104,683,798
May	12,982	612,607	8,658	335,401	2,356,641	104,902,235
June	12,191	590,657	9,797	365,589	2,359,040	105,127,861
Total for 6 months	81,721	....	....	......	....	....

Figures prepared by Car Service Division A. R. A.

Freight car repair situation

1925	Number freight cars on line	Cars awaiting repairs: Heavy	Light	Total	Per cent of cars awaiting repairs
January 1	2,293,487	143,962	47,017	190,979	8.3
February 1	2,305,520	139,056	47,483	186,539	8.1
March 1	2,313,092	141,192	43,855	185,047	8.0
April 1	2,315,732	143,329	43,088	186,417	8.1
May 1	2,316,561	144,047	45,467	189,514	8.2
June 1	2,320,261	146,998	48,988	195,986	8.4
July 1	2,326,734	150,530	47,938	198,468	8.5
August 1	2,335,223	153,674	43,607	197,281	8.4

Data from Car Service Division reports.

Month	Cars repaired: Heavy	Light	Total
December	66,615	1,288,635	1,355,250
January, 1925	69,084	1,358,308	1,427,392
February	66,283	1,313,088	1,379,371
March	71,072	1,348,078	1,419,150
April	69,631	1,290,943	1,360,574
May	65,651	1,276,826	1,342,477
June	71,789	1,296,558	1,368,347
July	70,087	1,330,595	1,401,682

borhood of 3,500. There were 180 exhibitors of machine tools and steel treating and testing equipment, and a great number of the exhibits were in actual operation. The technical sessions were well attended and the appreciation of the many excellent papers presented was indicated by the discussion which followed. Among the subjects covered were tool steels, carburizing, welding and tool tempering and hardness testing.

The following officers were nominated: President, R. M. Bird, Philadelphia; vice-president, J. F. Harper, Milwaukee, Wis.; directors, R. G. Guthrie, Chicago, and H. Bornstein, Moline, Ill. Chicago was selected for the 1926 convention.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL—V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Regional meeting October 5-7, at Altoona, Pa. Technical program on transportation problems. Railroad Division. A. F. Steubing, Bradford Corp., 25 West Forty-third St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting, October 27 to 30, inclusive, Hotel Sherman, Chicago.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, Hotel Statler, Buffalo, N. Y. Next meeting October 15. A paper on Supplies—Their Distribution and Cost will be presented. Moving pictures of N. Y. C. scrap yard at Cleveland.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

CINCINNATI RAILWAY CLUB.—W. C. Coder, Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. D. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month except July, August and September, at Hotel Cleveland, Public Square, Cleveland.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 1809 Capitol Ave., Omaha, Neb. Next meeting May 11-14, 1926, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting October 13. A paper will be read by J. H. Hustis, president, Boston & Maine.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday each month, except June, July and August, at 29 West Thirty-ninth St., New York. Next meeting October 16. Younger men's night.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 625 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern Railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

The National Lock Washer Company has moved its Chicago offices from 1535 Lytton building to 1103 Straus building.

G. P. Donelson, formerly president of the Continental Bolt & Iron Works, Chicago, died in California on September 3.

The General American Tank Car Corporation has acquired the plant of the Lone Star Tank Company of Fort Worth, Tex., and Wichita Falls.

John H. Ohlsson, assistant general manager of sales of the J. G. Brill Company, died suddenly on September 3, at his home in Philadelphia, Pa.

The Independent Pneumatic Tool Company, Chicago, has opened a branch office at 288 East Water street, Milwaukee, Wis., in charge of G. H. DuSell.

G. H. Woodroffe has been appointed metallurgical engineer, a newly created position, of the Reading Iron Company's boiler tube department at Reading, Pa.

The Marlin-Rockwell Corporation, New York, manufacturers of ball bearings, has purchased the plant of the Strom Ball Bearing Manufacturing Company, Chicago.

John J. Hannahan, assistant to the president of the Locomotive Stoker Company, Pittsburgh, Pa., died at his home in Merriam Park, Minn., on September 4, after a brief illness.

Stephen F. Sullivan, vice-president of the Ewald Iron Company, with headquarters in Chicago, died in Benton Harbor, Mich., on September 6, after a short illness of heart trouble.

E. J. Bartlett, general manager of the Baker R & L Company, Cleveland, Ohio, has been elected president, to succeed F. W. Treadway, who has been made chairman of the board of directors.

L. M. Zimmer has been appointed general sales manager of the Linde Air Products Company, manufacturers of oxygen, and of the welding gas division of the Prest-O-Lite Company, Inc., manufacturers of dissolved acetylene, succeeding L. M. Moyer, resigned.

Victor W. Ellet has been appointed sales manager of the Hunt-Spiller Manufacturing Corporation, with headquarters at Boston, Mass., in succession to John G. Platt, whose jurisdiction as vice-president has been extended to cover operation as well as sales.

Milburn Moore, eastern engineering editor of the Railway Age and Railway Engineering and Maintenance, has resigned to become associated with the Verona Tool Works, Pittsburgh, Pa., as district sales manager, with headquarters at 50 Church street, New York.

The Independent Pneumatic Tool Company, manufacturers of Thor pneumatic tools and electric tools, has opened a branch office at Milwaukee, Wis., in charge of G. H. Du Sell, who has represented the company in this territory for a number of years. The new office will be located at 288 East Water street.

The Hulson Grate Company, Inc., Keokuk, Iowa, which bought the Pechstein Iron Works, in Keokuk, last April, has recently placed the plant in operation. The machine and boiler shops have been discontinued and the foundry has been re-equipped and modern machinery installed for the manufacture of Hulson grates.

Joseph V. Miller, western sales representative of the Prime Manufacturing Company, Milwaukee, Wis., has resigned to go to the Chicago, Milwaukee & St. Paul as assistant general storekeeper. C. Arthur Dunn, eastern sales representative of the Prime Manufacturing Company, with headquarters at Philadelphia, has been promoted to sales manager, railway division, with headquarters at Milwaukee.

The Locomotive Terminal Improvement Company, Chicago, has taken over the manufacturing department of the National Boiler Washing Company, Chicago. This includes the manufacture of leadized pipes, leadized boiler tubes for both locomotive and stationary use, post and pillar cranes, and other locomotive terminal facilities. Officers of the Locomotive Terminal Improvement Company are: President, Spencer Otis, president of the National Boiler

Washing Company; secretary and treasurer, John S. Maurer, vice-president and treasurer of the National Boiler Washing Company; chief engineer, F. S. Wichman, chief engineer of the National Boiler Washing Company; and sales engineer, W. J. Wignall, of the engineering and purchasing department of the National Boiler Washing Company.

M. A. Weidmayer, formerly branch manager of the Black & Decker Manufacturing Company, is now in charge of the Philadelphia office of the United States Electrical Tool Company, and C. H. Scaffe, formerly connected with the Black & Decker Manufacturing Company at St. Louis, is now a special representative of the United States Electrical Tool Company, operating from the general office at Cincinnati, Ohio.

The C. H. Hollup Corporation, formerly the International Welding Engineering Corporation, Chicago, manufacturer of welding wire and supplies, has purchased 15,000 sq. ft. of land on South Turner avenue and West 48th Place, upon which it will construct a factory building. The building will have approximately 12,000 sq. ft. of floor space and will be of brick and mill construction with faced brick, terra cotta trimmed on the north and east ends.

L. G. Plant, assistant to the president of the National Boiler Washing Company, Chicago, has resigned to engage in selling and financing locomotive terminal utilities, with offices in the Railway Exchange building, Chicago. He will represent the T. W. Snow Construction Company as general railway sales agent for this company's unit system locomotive coaling station and the Locomotive Terminal Improvement Company as general sales agent for the direct steaming system.

The Dearborn Chemical Company contemplates the construction of a warehouse in Los Angeles, Cal., while the plant under construction in Chicago will be ready for occupancy on October 17. This company has appointed V. Cattoretti & Co., La Paz, Bolivia, its agent for oils and greases in Bolivia. It has also appointed Graham, Rowe & Co., Lima, Peru, its agent for oils and greases. This company has been agent for the Dearborn Chemical Company for its water treatment service and chemicals.

E. H. Wood, former master car builder of the Michigan Central, has joined the sales force of the Grip Nut Company as district sales manager, with headquarters in Chicago. Mr. Wood entered the service of the Canadian Pacific as a car repairer in 1899, and subsequently was successively car inspector, foreman, general foreman and general car foreman until September, 1915, when he resigned. The following month he went to the Michigan Central as inspector at Kensington. He was appointed general car foreman in November of the same year, and assistant master car builder in May, 1919. Mr. Wood was appointed master car builder in May, 1920, and later became passenger car foreman at Chicago, remaining in that service until January of this year.

E. H. Wood

John T. Llewellyn, vice-president of the Chicago Malleable Castings Company and president of the Allied Steel Castings Company, Chicago, has been elected president of the Chicago Malleable Castings Company, to succeed Silas J. Llewellyn, deceased. James S. Llewellyn, secretary of the Chicago Malleable Castings Company, and secretary and works manager of the Allied Steel Castings Company, has been elected vice-president, general manager and secretary of the Chicago Malleable Castings Company, and vice-president, general manager and secretary of the Allied Steel Castings Company. Paul Llewellyn, treasurer of the Chicago Malleable Castings Company and vice-president of the Interstate Iron & Steel Company, has been elected vice-president and treasurer of the Chicago Malleable Castings Company.

John T. Llewellyn was born in Briton Ferry, Wales, and came to America in 1864. He was educated in the public schools of Cleveland, Ohio, and Chicago, and in 1880 he entered the employ of the Illinois Steel Company as a telephone operator. In 1896 he organized the Valve Setting Company, Racine, Wis., and in 1898 he organized the Chicago Malleable Castings Company, of which he has since been vice-president and general manager. James S. Llewellyn was born in 1887 in Milwaukee and was graduated from the University of Michigan in 1908. After leaving school he entered the employ of the Chicago Malleable Castings Company and worked in the shops, occupying several positions until 1915, when he was appointed secretary, which position he has held until his recent promotion. Paul Llewellyn was born in 1886 and was educated at Yale University. In 1908 he entered the employ of the Interstate Iron & Steel Company, since which he has been manager of the East Chicago works, sales manager, vice-president of the latter company and treasurer of the Chicago Malleable Castings Company.

William H. Heulings, Jr., vice-president and general manager of sales of the J. G. Brill Company, Philadelphia, died on September 14 in the Jefferson Hospital, that city, after a brief illness. Mr. Heulings has been identified with the Brill Company since boyhood, starting in February, 1885, as a stenographer. He was transferred to the sales branch of the business at the age of twenty and became assistant secretary of the company in 1901, and in 1903 assumed, in addition, the duties of general manager of sales. In June, 1914, he was elected vice-president and held this joint responsibility at the time of his death. Mr. Heulings was born on November 17, 1869, in Philadelphia, and received his education in the public schools of that city. He was also vice-president and a director of the American Car Company, St. Louis, Mo., and a director of both the G. C. Kuhlman Car Company, Cleveland, and the Wason Manufacturing Company, Springfield, Mass., subsidiaries of the J. G. Brill Co.

W. H. Heulings, Jr.

Control of the Hall-Scott Engine Company, Oakland, Calif., manufacturers of motors for the Fageol Motors Company, has been acquired by the American Car & Foundry Company. The J. G. Brill Company is associated with the American Car & Foundry Company in this purchase. Reports are current that control of the Brill Company is about to pass to new interests. One rumor is to the effect that there is in contemplation the formation of a new company to be controlled by the American Car & Foundry Company or interests associated with the latter. The new company, it is said, will take over control of the Brill Company, the Hall-Scott Engine Company and the Fageol Motors Company, of Ohio. The American Car & Foundry Company has issued the following statement denying these rumors:

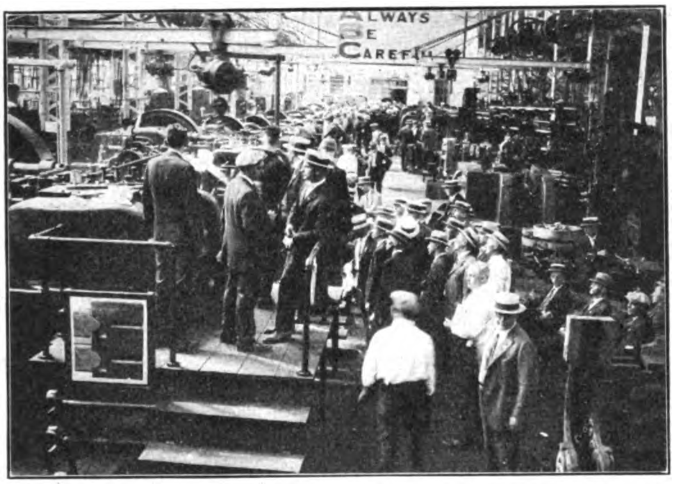
> Following the announcement that American Car & Foundry Company had purchased a controlling interest in the Hall-Scott Motor Car Company of Berkeley, Cal., it was persistently rumored that it had also acquired certain companies to whom Hall-Scott Company had been supplying gas engines for use in motor trucks, buses, etc. Fageol Motor Company of California, Fageol Motor Company of Ohio and the J. G. Brill Company were mentioned as having been thus acquired. American Car & Foundry Company denies that it has purchased control of these or any other customers of the Hall-Scott Company, and states that the rumors are unfounded.

National Machinery Company exhibits forging machinery

The National Machinery Company held its second annual exhibition and demonstration of forging machinery at its plant, Tiffin, Ohio, August 21 to 26, 1925, inclusive. The first day of the exhibition was set aside as Master Blacksmiths' day, and practically

all those in attendance at the convention of the International Railroad Master Blacksmiths' Association at Cleveland, Ohio, attended. Special arrangements were made for the transportation of the members and other guests between Cleveland and Tiffin.

This exhibition was the second of its kind to be conducted by the National Machinery Company, the first being held fifteen years ago. The entire plant was used for the exhibition of the various machine tools, production work practically ceasing while the exposition was in progress. A total of 62 machines, of which 35 were



Visitors watching a demonstration—62 machines were on exhibition, 35 of which were in operation

in operation, and 10 furnaces were on exhibit. Forging machines ranging from 1 in. to 5 in. capacity, each equipped with the necessary dies and furnaces, were in actual production on forging jobs. A number of continuous automatic feed bolt and rivet headers were also in operation, in which many improvements designed to expedite production have been incorporated. In addition there were on exhibit, bolt heading machines fed by a new type of automatic electric header, semi-automatic bolt heading machines, semi-automatic and automatic nut tappers, automatic thread bolt trimmers, rolled thread bolt machines and a battery of bolt cutters. These

Interior view of the National Machinery Company's plant, Tiffin, Ohio, during the exposition

bolt machines constituted a complete bolt producing plant. Some of the more interesting forging jobs demonstrated to the master blacksmiths the possibilities of the forging machine in railway blacksmith shop work for the production of locomotive cylinder cocks, brake lever fulcrums, side rod nuts, freight car floor bolts, brake hangers, locomotive ash pan levers, handholes or grab irons, and brake chain clevices.

The exhibition also demonstrated the various stages of manufacture of the machines produced by the National Machinery Company and how the various parts functioned when in actual operation.

Trade Publications

Screw, nut and stud drivers.—A 12-page brochure, descriptive of portable electric screw, nut and stud drivers, has been issued by the United States Electrical Tool Company, Cincinnati, Ohio. Charts showing capacities of different models and pilot hole sizes and specifications are also included.

Trucks and tractors.—A 40-page catalogue descriptive of the mechanical features of the various types of Crescent trucks and tractors and showing the purpose for which each type is particularly adapted, has been issued by the Crescent Truck Company, Lebanon, Pa. Specifications and line drawings are also included.

Regulators.—The Alexander Milburn Company, Baltimore, Md., has issued an eight-page brochure descriptive of its standard regulators for oxygen, acetylene and other gases. The rear opening of the Milburn regulator is only 1⅛ in. diameter, which enables the cap to be unscrewed and the seat and nozzle to be immediately reached without undoing any other part.

Vertical turret lathe.—A four-page bulletin showing front and back cylinder head operations on vertical turret lathes having diameters 30½ in., 32 in., 34½ in. and 36 in., respectively, has been issued by the Bullard Machine Tool Company, Bridgeport, Conn. The side head and turret, which provides additional tooling capacity, ample support for heavy cuts and simultaneous cutting facilities, is also described.

"Net profits from small lots."—This is the title of a 16-page booklet issued by the Warner & Swasey Company, Cleveland, Ohio, which shows the way to net profits from small lot production by the use of universal turret lathes with standard tool equipment, making five to fifteen pieces of one kind at a time, thus cutting the time in half as compared to engine lathe methods. Illustrations show comparative facts about keeping the machine busy, set-up time, production and the net profit from the investment.

Pressure regulating devices.—General catalogue No. 62, descriptive of its pressure regulating devices, has been issued by the Mason Regulator Company, Boston, Mass. The catalogue, which contains 178 illustrated pages, is divided into five sections, Section I being devoted to pressure reducing valves; Section II, to automatic regulating devices for pumps and pressure regulators; Section III, to boiler pressure regulators, damper regulators and fan engine regulators; Section IV, to balanced valves, companion flanges, strainers and pilot valves, and Section V, to tables for obtaining sizes of pressure reducing valves, general information for engineers and contractors, and telegraphic code.

Feedwater heaters.—Instructions for the operation and maintenance of the Elesco locomotive feedwater heater are contained in a 74-page handbook recently issued by the Superheater Company, New York. After a brief description of the principle used in its design, the Elesco heater and its parts are described. The succeeding chapters deal with the operation, maintenance, inspection and test of the equipment, how it is cleaned, heater and pump repairs, and questions and answers regarding operation. Charts show in colors the various passages of live and exhaust steam, hot and cold water through a locomotive equipped with the Elesco heater and the passages of steam and water through various parts of the heater itself.

Electrical supplies.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is distributing its new 1925-27 catalogue of electrical supplies. The publication contains 1,200 pages and is profusely illustrated with 4,500 engravings. All new apparatus designed and manufactured in the past two years, as well as all the previous established types are listed. A very complete subject index in the front of the book is printed on blue paper so that it can be quickly located, and a style number index for checking invoices is located in the back of the book. A classified index under such classifications as central stations, electric railways, industrial plants, mines, etc., gives a complete list of apparatus applicable to each of these groups of industries, and the thumb index enables the user to locate any section of the catalogue with the least inconvenience.

Personal Mention

General

F. A. Starr has been appointed supervisor of reclamation of the Chesapeake & Ohio, with headquarters at Richmond, Va.

P. C. Morales has been appointed superintendent of machinery and motive power of the National Railways of Mexico, succeeding S. A. Alzati, resigned.

J. P. Roquemore, superintendent of motive power of the International-Great Northern at Palestine, Tex., has been promoted from mechanical assistant to executive vice-president, with headquarters at Houston, Tex., a newly created position.

S. T. Armstrong, master mechanic of the San Antonio division of the International-Great Northern at San Antonio, Tex., has been promoted to superintendent of motive power, with headquarters at Palestine, Tex., in place of J. P. Roquemore.

Master Mechanics and Road Foremen

O. C. Branch has been appointed road foreman of engines of the North Carolina division of the Seaboard Air Line, with headquarters at Hamlet, N. C.

George B. Riddle has been appointed assistant road foreman of engines of the North Carolina division of the Seaboard Air Line, with headquarters at Hamlet, N. C.

F. R. Butts has been appointed acting master mechanic of the Brookfield division of the Chicago, Burlington & Quincy, with headquarters at Brookfield, Mo., to succeed H. H. Urbach, who has been assigned to other duties.

Ammon Hambleton, whose appointment as master mechanic of the El Paso-Amarillo division of the Chicago, Rock Island & Pacific at Dalhart, Tex., was announced in the August issue of the *Railway Mechanical Engineer*, was born on November 4, 1883, at Aroca, Kans. He graduated from the Atchison, Kans., high school, and in January, 1900, entered the employ of the C. R. I. & P. at Horton, Kans., as a machinist apprentice. In July, 1902, he was transferred to the new Chickasha, Okla., shops, where he completed his apprenticeship in January, 1904. He then served as a machinist until November of the same year, when he was promoted to machine shop foreman. From October, 1906, to January, 1907, he was a machinist at Shawnee, Okla.; from January, 1907, to July, 1910, machine foreman, and from July, 1910, to April, 1914, roundhouse foreman, being transferred on the latter date to Chickasha, as general locomotive foreman. He was transferred to Shawnee as general locomotive foreman in April, 1917, and in April, 1920, appointed master mechanic of the Louisiana division, with headquarters at El Dorado, Ark. In June, 1921, the Louisiana division was consolidated with the Arkansas division under the jurisdiction of the Arkansas division staff, and Mr. Hambleton was transferred back to Shawnee as general foreman, locomotive department, in which position he remained until his appointment as master mechanic of the El Paso-Amarillo division.

A. Hambleton

Car Department

W. P. Pettus, car foreman of the Chicago & Eastern Illinois, at Terre Haute, Ind., has been appointed car foreman of the Gulf Coast Lines, with headquarters at Kingsville, Tex.

G. T. Patton has been appointed car foreman in charge of freight cars of the Baltimore & Ohio, with headquarters at Mt. Clare, Baltimore, Md., succeeding J. F. Ford, resigned.

Shop and Enginehouse

W. K. Gonnerman has been promoted to superintendent of shops of the entire Akron division of the Baltimore & Ohio.

A. E. Spurr has been promoted to assistant enginehouse foreman of the Northern Pacific, with headquarters at St. Paul, Minn.

E. J. Cole, superintendent of shops of the Union Pacific at Cheyenne, Wyo., has been transferred to Omaha, Neb., succeeding J. W. Highleyman.

J. W. Highleyman, acting superintendent of shops of the Union Pacific, has resumed his duties as assistant superintendent of motive power and machinery.

B. F. Hoard, assistant enginehouse foreman of the Northern Pacific at St. Paul, Minn., has been promoted to enginehouse foreman, with headquarters at Jamestown, N. D.

W. C. Rogers has been appointed supervisor of passenger locomotive operations on the South Carolina division of the Seaboard Air Line, with headquarters at Savannah, Ga.

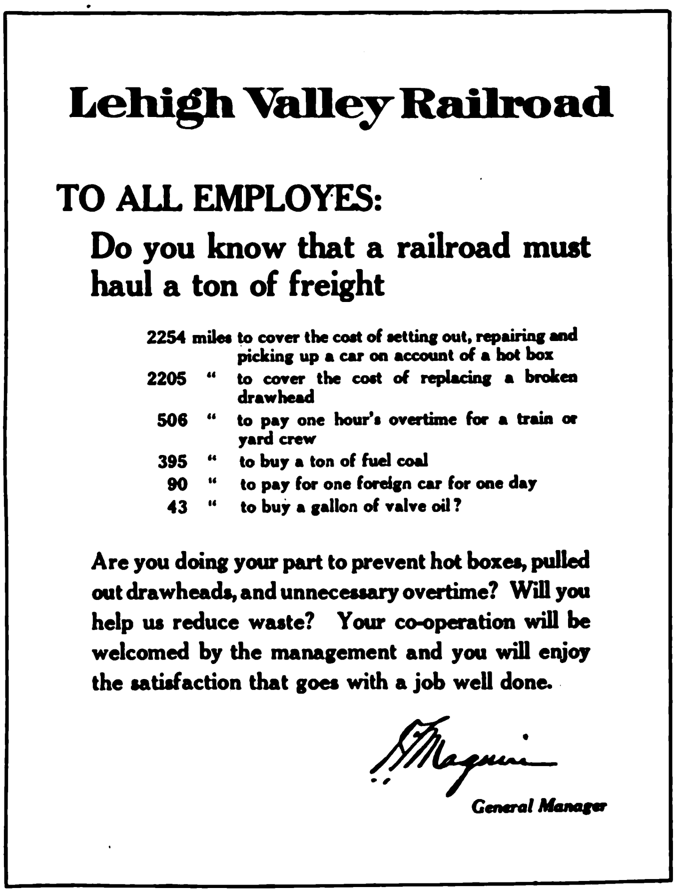
B. Koontz has been appointed supervisor of passenger locomotive operations on the Virginia and North Carolina divisions of the Seaboard Air Line, with headquarters at Raleigh, N. C.

Purchases and Stores

C. L. Tiller has been appointed division storekeeper of the Southern, with headquarters at South Richmond, Va., succeeding W. N. Pollard, deceased.

Obituary

J. H. Daley, mechanical superintendent of the New York, New Haven & Hartford, died in a hospital at Auburn, N. Y., on August 28.



Poster used on the Lehigh Valley in a campaign to prevent hot boxes

Railway Mechanical Engineer

Vol. 99 November, 1925 No. 11

The master workman uses great care in selecting his tools and keeping them in first-class condition. The officer or foreman is judged by the results he gets from his organization or the particular part of the organization over which he has control. He must constantly study to improve his ability and to exert a higher type of leadership. He needs good tools just as does the mechanic, but they are naturally of a very different sort. Among his tools are a knowledge of the right principles of dealing with the human element, of the best methods and practices of doing work over which he has supervision, and the best types of facilities and equipment for use in his department. Progress is continually being made in all these matters. It is no small task to keep up with this progress, even for a foreman who has a comparatively limited part of the organization under his direction. It requires constant study and a knowledge of what is being done by others in the same class of work. The *Railway Mechanical Engineer* is specially designed to meet these needs of railway mechanical officers and foremen.

Using the Railway Mechanical Engineer

It is not easy for the average man to read or study books or technical publications, but nevertheless it is vital for him to do so if he expects to advance or even to hold his own if he is in a supervisory position. The men at the head of an organization or a department have a grave responsibility in seeing that those associated with them are properly encouraged and inspired to develop and make better use of their peculiar talents. One of the contributors to this number, whose letter is included in the article on the "Bill Brown-Top Sergeant" controversy, speaks feelingly of the lack of encouragement which he received from his superiors in this respect. Is there not here a lesson for every man holding a supervisory position, even though he is only a gang foreman? In the latter case there are quite likely to be ambitious men or young men working for him who are sadly in need of a bit of help and encouragement in getting a larger appreciation of the possibilities which lie before them and the best ways in which to prepare themselves to make the most of their opportunities.

Our advertising pages

One of the men quoted in the article on the "Bill Brown-Top Sergeant" controversy pokes fun at "Bill Brown" because of the statement that he made in commenting upon the necessity of reading the *Railway Mechanical Engineer*, and the Railway Age, that "the advertising columns alone are an education." It seems hardly necessary to comment upon this statement and yet our attitude might be misunderstood if we allowed it to go unquestioned. There was a time not so many years ago that the advertisers used only small space, seldom changed their copy and the advertising pages were little more than a directory. Today, however, many of the advertisers spend much time and money in securing accurate data and illustrations to show the working and advantages of their products, change the copy with each issue and use large spaces, that it may be effectively displayed. We have received many letters from readers of the *Railway Mechanical Engineer*—including three railroad presidents within recent months—commenting on the practical information contained in the advertisements and their helpfulness and value. In other words, "Bill Brown's" statement is typical of a large number of similar expressions which have come to us unsolicited. Sometimes, indeed, the editors have been a bit embarrassed because they have been informed that some of the readers, at least, turn first to the advertising pages when they take the wrappers off their copies.

The task of the mechanical department officer

The average mechanical department officer is perhaps more apt to consider his job as one primarily concerned with machines, material and men, taken in the order named, than anything else. It is an inspiration, however, to get another view, in which this order has been reversed, which was brought out in a talk made by the head of the mechanical department of a large western railroad at a meeting of his staff a number of months ago. In his remarks the ideal of rendering service was specially emphasized and we can do no better in passing this ideal along to others than by quoting directly a portion of his talk which is as follows:

"The most fundamental task of the officer in charge is to awaken, without any semblance of personal self-gain, an interest in and a desire for knowledge and self-development in those he has jurisdiction over. In considering this question, the officers in charge of this department are chiefly concerned in dealing with and studying this subject with respect to incentives, rewards, jealousies, rivalries, discontents, loyalties, ambitions, and aspirations. Our vice-president is primarily concerned in determining motives, intentions and responsibility. Our president is primarily concerned with relative values and the means to make real the highest values in each of us, . . . with a single motive in mind: the good of the great transportation system we are privileged to serve. When all is said and done, we cannot accept any account, any description or explanation of our combined effort which leaves out of the picture this all important aspect that we call impulse, desire, striving towards a goal. . . . Let our aim for the future be one of enlarged viewpoint, free of every small and selfish contact with only one purpose in mind to render as nearly perfect a service as possible, based on the highest principles of attainment in every respect.

"No man can be so much of a man, in any one direction,

as when he is a whole man in that direction. The fellow who can concentrate his whole being, all his energies and all his capabilities, for the compassing of the one thing on which his mind is fixed, is obviously more effective, in behalf of that object of his endeavor, than would be possible were his energies divided, and were only a portion of himself given up to that for which he is striving. And this power of concentration is that which makes the preeminent practical efficiency in any sphere of human endeavor."

This idea of the fundamental task of the mechanical department officer is old in many respects, but we find it presented here from a new angle. Its application, however, is not necessarily limited to the mechanical department. Any man who has charge of the work of other men can profit by the suggestion—first of all, aim to render service and finally know how to concentrate.

A bundle of sticks

Many years ago, the father of several sons, calling them before him shortly before his death, is said to have presented to them a bundle of sticks snugly bound together and to have asked each in turn to break them. Each in turn failed. The father then, removing the bond which held the bundle together and taking the sticks one at a time, broke all of them. This simple object lesson, presented to show the importance to the sons of maintaining family unity, is suggestive of the importance of unity and cohesion in many other situations and, perhaps, in none more than in the mechanical department budget for capital expenditures. A budget made up of numerous unrelated items for a new machine tool here, a new ash pit there and the extension of a few roundhouse stalls elsewhere may be compared to the sticks in the bundle after the cord which bound them had been removed. Each item must be defended separately and no matter what possibilities it offers for savings in the unit costs of detail operations, it is extremely difficult to prove its indispensability. On the other hand, a budget which represents a well-considered plan, perhaps looking a decade into the future as well as considering the immediate needs, carefully co-ordinated and spread over a period of years, at the end of which a definite reduction in the maintenance cost per locomotive or car-mile may be expected, the aggregate of which will show in improved net operating income, provides each item with the support of all of the others, just as each of the sticks in the bundle added to the strength of all of the others. A ten million dollar plan, for which results may be predicted in terms which mean something to the executive, is stronger than a succession of one hundred thousand dollar budgets each made up of poorly correlated items, the savings from one of which are large enough to be found when carried through to net operating income.

What are your machine tools doing?

The mechanical department of an eastern railroad has just completed the installation of new machine tools and equipment in nine of its shops. The past record of this road bears out the statement of the department head that "the procurement of this new equipment is in line with the well established practice of this road to retire equipment as it becomes inefficient and obsolete, and to replace it with modern, up-to-date equipment." He also says that, "the shops on this road are operated on a piece-work basis and the system is such that it quickly develops any inefficiency in machine tools." Our attention is called to a new 90-in. journal turning and quartering machine installed in a locomotive repair shop. Previous to the installation of the new machine, an old driving wheel lathe that had been altered and reassembled was used as a journal turning lathe. The work done on this old machine was generally unsatisfactory and expensive. The output of the machine was limited and quite often the shop management found it necessary to allow journals and crank pins to remain in service that should have been reconditioned. The fact that the shop was not properly equipped to turn journals and crank pins and keep them in proper quarter often resulted in locomotives being sent out of the shop in unsatisfactory condition, necessitating increased expenditure for repairs at the enginehouses and resulting in unsatisfactory performance of the locomotives on the road. The new machine will keep the journals and crank pins properly trued up and in quarter on all the locomotives that go through this shop, which has an output of approximately 30 locomotives a month.

Proper and adequate records of the production of all your machine tools will show when a tool is failing to meet requirements. To keep a machine tool in service that retards shop production or with which it is impossible to do the right kind of work is an expensive investment for any road. It pays to know what your machine tools are doing.

Help the younger men

One cannot but be impressed by the remarkable changes that have taken place in the railway mechanical field during the past decade. It is difficult even at this time to understand the full significance of these changes or to see them in their proper perspective. Have some of these developments made us lose sight of the necessity of helping and training the younger men to prepare themselves for the larger responsibilities which they must assume in the future? Industry and transportation have been growing at an extremely rapid pace and the problems of organization have been becoming more and more complicated. There is every sign, indeed, that these problems will continue to increase in number and extent with the continued growth of the railroads and under economic pressure. This will require much bigger and better trained men in the future, not alone in supervisory positions, but among the workers as well. Are we doing all that we should to discharge our responsibilities in this matter?

It may be well to review briefly some of the general movements under way to provide better trained men and better leadership for the future. Modern apprenticeship, inspired in this country by George M. Basford and typified by the methods in vogue on the Santa Fe and the New York Central, has gradually been receiving the support of more and more mechanical department officers and a considerable number of roads are now following approved practices in this respect. Unfortunately many roads have failed to face to this question in a big way. Even on roads where the best apprenticeship methods are being followed; however, it is important that broad-gage, big-hearted officers and men should stand ready to help and encourage the young men as individuals to recognize their opportunities and to persist in studying to improve themselves. A friendly word or a pat on the back will often go a long way in putting new energy into young men who naturally sometimes grow discouraged in their work.

During the latter part of this month there will be held in Pittsburgh the third of what have become known as Younger Railroad Men's Conferences. These have been held under the direction of the Railroad Y. M. C. A., the purpose being to gather together annually for a three-day conference representative young men from different departments and different railroads in this country and

Canada. The aim is to get the younger men to recognize the importance of the railroads in our economic, social and political structure and the opportunities in this field. The fact that a strong man must be properly balanced, is presented to them in the four-fold program of the Y. M. C. A. Then, too, with the help of practical railroad officers, an effort is made to have the boys check up to see that they are in the particular branch of railroading that they are best fitted for and as to how they may best prepare themselves for advancement. The boys, on the basis of former conferences, will go back to their home towns and will help their fellows grasp the spirit of the conference and profit from it in a practical way. Then, too, these conferences in many cases have opened the eyes of railroad officers to their responsibilities and opportunities in encouraging young men and helping them to find their proper places in the organization.

That these things appeal to the practical, hard-headed railroad officer is indicated by the fact that several of the railroad clubs have inaugurated "Younger Men's Nights." Few meetings of the New York Railroad Club have attracted so great attention, for instance, as the one last month, at which seven young men from as many different railroads and as many different occupations, gave 12-minute talks in which they told something of their experiences and problems, as well as what they conceive to be the opportunities in their particular work. From these it was clearly evident that these young men are not expecting favors, but that they recognize that they must make good by hard work and real ability. What they do ask, however, is that a reasonable effort be made to give them the right kind of information and training and to help them gain a larger appreciation of what the railroads mean and how they, as individuals, can render the largest degree of service.

New Books

PROCEEDINGS OF THE INTERNATIONAL RAILWAY FUEL ASSOCIATION, 1925. *Edited by the Treasurer, J. B. Hutchinson,* 1809 *Capitol avenue, Omaha, Neb.* 526 *pages, illustrated. Price* $3.00.

This book contains the proceedings of the seventeenth annual convention of the International Railway Fuel Association which was held in Chicago, May 26 to 29, 1925. The reports submitted include boiler feedwater heaters; front ends, grates and ash pans; stationary plants; Diesel locomotives; fuel stations, and firing practice. The book also contains the following papers which were read before the convention by men in the railroad field interested in fuel conservation: Signals and the saving of fuel; How can the railroad management effect fuel economy? How can fuel purchases effect fuel economy? The development of oil burning practices on locomotives; Fundamental fuel factors; How can a mechanical officer effect fuel economy? Back pressure as an index of fuel economy, and the N. A. P. A. coal chart.

THE AIR BRAKE ASSOCIATION PROCEEDINGS, 1925. *Edited by the secretary, F. M. Nellis,* 165 *Broadway, New York.* 350 *pages, bound in leather.*

The proceedings of the thirty-second annual convention of the Air Brake Association which was held at Los Angeles, Cal., May 26-29, 1925, is the testimony of what a railway association can do in the way of constructive work through proper committee organization. The book contains an unusual amount of practical information which is due largely to the manner in which the various committees and air brake clubs handle their reports and papers. The subjects discussed at this year's convention covered practically all phases of air brake work. The reports submitted covered: What is the best material for air brake and air signal piping? Passenger train handling; Graduated release; Condemning limits of A. R. A. standard triple valve parts; What are you specifying and what are you getting in foundation brake rigging on car equipment? Brake pipe leakage; More efficient air compressors; Recommended practice; Triple valve slide valve, leakage indicator; and Automatic train control. The reports of the secretary, treasurer and various committees are also included.

PRINCIPLES OF LOCOMOTIVE OPERATION, *by Arthur Julius Wood, professor of mechanical engineering, The Pennsylvania State College.* 315 *pages, illustrated,* 6 *in. by* 9¼ *in. Bound in cloth. Published by the McGraw-Hill Book Co., Inc., New York. Price,* $3.00.

The first edition of this book, which was published under the title of the "Principles of Locomotive Operation and Train Control," has been used quite extensively as a text book in technical schools and as a reference book by many railway mechanical department officers. This, the second edition, is a worthy successor of its predecessor for the author has included in its revision the most recent developments, both theoretical and practical, in the design and construction of the steam locomotive. Prof. Wood has shown the locomotive as a power plant to which the maximum possible amount of energy in the fuel should be available at the drawbar. The application of the laws of mechanics and thermodynamics are brought out by a number of practical examples which point the way to a solution of the more involved problems in proportioning and design.

It is well for those who are being initiated into the mysteries of the locomotive to consider at the outset the application of the fundamental laws of mechanics as applied to locomotive design and operation. Hence, the book begins by defining the purpose of a locomotive in terms of these laws. The purpose of a locomotive is to do work. Work is the overcoming of resistance through space and is, therefore, the product of the two quantities; namely, a force, and the distance through which the force acts. The utilization of heat energy for the performance of useful work and the various changes through which it must go in order to perform useful work at the drawbar, are discussed in the introductory chapter. The author's method of handling these fundamentals of locomotive design and operation cannot help but refresh the mind of the student who has already studied his thermodynamics and mechanics.

Railway mechanical department officers will find this book to be a valuable addition to their reference libraries. The arrangement of the book is such as to provide quick access to information on the various subjects incidental to locomotive design, construction and operation. A list of the chapter headings and a few of the sub-divisions in each chapter will give the reader some measure of the thoroughness with which the author has covered the subject. These are as follows: Principal Types of Locomotives; Determining the Tractive Force for Two and Three-cylinder Locomotives; Acceleration of Trains; Train Resistance; Effect of Air and Temperature on Resistance; Curve Resistance; Speed-Time Curves as Applied to Locomotive Performance; Dynamometer Cars and Tonnage Rating; Air Brakes and Brake Rigging; Combustion and Fuel Economy; The Formation and Action of Saturated and Superheated Steam; Valve Motion; Locomotive Ratios or Factors; The Proper Selection and Use of Locomotive Ratios; Counterbalancing; Locomotive Testing; Modernizing the Locomotive. The book also contains an

appendix in which is given a number of convenient tables for use in design and calculation.

The chapter on tractive force includes a discussion of the effect of inertia of reciprocating parts, and the effect of speed on the tractive force developed by a locomotive. In showing the development of the Kiesel formula for calculating the cylinder tractive force for saturated locomotives, the author has supplied constants that may be substituted in this formula when determining the tractive force of superheated locomotives. These constants are intended to eliminate the usual difficulty encountered in determining the true average rate of evaporation and the effect of the superheater surface. This chapter also discusses the various factors entering into the calculation of the tractive force for three-cylinder, four-cylinder compound, Mallet four-cylinder compound, and for locomotives equipped with boosters.

In the revision of the text, a number of problems have been added on the design of foundation brake rigging, a discussion of the time lost in slow-downs and descriptions of the latest developments in stokers, feedwater heaters, brick arches and boosters. There is also included a method for laying out a Walschaert valve gear; factors and ratios for empirical design; a discussion of the theory of steam locomotive development; calculations for counterbalancing, and a discussion on modernizing the locomotive. The chapter on the formation and action of steam has been entirely rewritten and includes the most recent data on boiler performance.

While intended primarily for use in technical schools, this book furnishes railway engineers and officers interested in locomotive design and operation a concise review of the theory on which certain problems in locomotive design and construction are based. In revising and bringing up-to-date his original work, the author has fulfilled the wishes of many mechanical department officers.

What Our Readers Think

Locomotive efficiency—Past and present

GALVESTON, TEX.

TO THE EDITOR:

I have been quite interested in reading the editorial entitled "Locomotive efficiency improves," in the September issue of the *Railway Mechanical Engineer.*

Surely the writer of the editorial does not mean to intimate that a drawbar pull of 22,078 lb. represents the maximum capacity of the Pennsylvania 2-8-0 locomotives of Class H-6-A. If he will turn to page 141 of the book, "Locomotive Tests and Exhibits," issued by the Pennsylvania, the following significant statement will be found: "Higher drawbar pulls were not obtained because at slow speeds and long cut-offs there was constant danger of stalling the brakes and slipping the drivers, owing to the fluctuations of the pressure of the water used for controlling the brakes."

Since the testing plant has been moved to Altoona, these limitations have not applied and, therefore, the maximum drawbar pulls obtained at present are by no means comparable with those registered at St. Louis.

If it is desired to compare the most advanced locomotive practice of today with that of 21 years ago, solely on a basis of fuel economy and general efficiency, why ignore the performance recorded by the Michigan Central locomotive No. 585 on the St. Louis plant? This locomotive, despite its limitations in other respects and notwithstanding the fact that it possessed but few of the fuel-saving refinements which are now found so essential, need not fear comparison with today's best machines on an efficiency basis.

Michigan Central cross-compound 2-8-0 locomotive No. 585

	Maximum	Minimum
Dry coal per d. h.p. hr., lb.	3.61	2.14
Boiler efficiency, per cent	78.42	49.81
Machine efficiency, per cent	94.16	74.98
Locomotive efficiency, per cent	8.04	4.80

WM. T. HOECKER.

The evaporative capacity of locomotives

BURNHAM, PA.

TO THE EDITOR:

In his rather elaborate study of the evaporation in locomotive boilers in the August and September issues of the *Railway Mechanical Engineer,* Mr. Poperev criticizes the accuracy of some methods I have used in analyzing tests of locomotive boilers. May I suggest that before this criticism is taken too seriously, careful consideration be given to the purposes for which my methods were developed and also to the rather antiquated foundation on which two out of three of Mr. Poperev's elaborate equations are built.

In studying the relation between steam produced and coal used, I have shown that within the range of experimental results available, the boiler efficiency if plotted against the rate of firing follows closely a straight line relation. In a recent account* of the use of this relation I wrote—

> This method of plotting boiler efficiency against rate of firing is of considerable value in the study of locomotive operation. In all tests of coal burning locomotives that the writer has examined the straight line relation between boiler efficiency and rate of firing is characteristic. It does not seem possible to connect this straight line relation to any fundamental laws, but experience shows that as an empiric rule it can be safely counted on.

Mr. Poperev states that there are "convincing reasons for doubting the correctness of the method accepted by Mr. Fry," but he shows nothing which contradicts the statement above. His only criticism is that for very low rates of evaporation the straight line relation will not hold. Theoretically the point is well taken, but it has little practical importance as the rates of evaporation at which the relation departs perceptibly from a straight line are lower than occur in any tests available and much lower than are met with in practice. Within the range of working covered by the tests, the complicated hyperbolic curve for boiler efficiency chosen by Mr. Poperev flattens out so much that for all practical purposes it is indistinguishable from a straight line. Since there is no advantage given by the more complicated curve at normal rates of evaporation, it is preferable to use the straight line on account of its simplicity and the ease of determining the constants corresponding to any given set of test results.

Apart from the increase in complication without a corresponding increase in practical accuracy, further criticism of the Poperev equations may be made on the score that too broad a generalization is attempted from too narrow a body of data.

It is shown that the relation between equivalent evaporation and the rate of firing can be closely approximated by an equation of the form—

$$Ze = a + bY + cY^2 \text{ ——— } (1)$$

Where Ze is the equivalent evaporation per sq. ft. of heating surface per hour, Y is the rate of firing in pounds

* A Study of the Locomotive Boiler, by Lawford H. Fry, page 46.

of dry coal per sq. ft. of grade per hour and where *a* is a constant and *b* and *c* are coefficients dependent on the boiler design and quality of fuel.

Three groups of equations are given by Mr. Poperev for determining the values of *b* and *c* from the boiler dimensions and the heating value of the coal. The number of boiler tests in each group is as follows:

1—For boilers using bituminous coal with firebrick arch, seven tests.
2—For boilers using semi-bituminous coal with firebrick arch, six tests.
3—For boilers using semi-bituminous coal without firebrick arch, six tests.

Now as far as the equations in groups 2 and 3 are concerned, it should be noted that the semi-bituminous coal used was of a type shown by the tests to be poorly adapted to locomotive use, and none of the boilers had superheaters or combustion chambers, so that the tests are not representative of modern practice. The boilers and coals of the tests in group 1 are representative of good current practice, and probably the coefficients given are applicable to the seven tests in this group, although very little direct evidence as to this is offered. It is highly questionable though whether the equations given for determining the coefficients are generally applicable to boilers of other designs. The only two variables taken into account in these equations are the heating value of the coal and the ratio of evaporative surface to grate area. Very little study of tests made on locomotive boilers is required to show that these two variables are entirely inadequate to characterize completely the operation of any given boiler. Boiler efficiency can only be studied properly if it is separated into its two components, i.e., efficiency of combustion and heat production, and efficiency of heat absorption. The efficiency of heat production will be affected not only by the ratio of heating surface to grate and by the heating value of the coal, but also by the amount of air admitted to the firebox, by the relative volume of the firebox, by the size in which the coal is fired, and by the method of firing, whether hand or stoker, and further by the efficiency with which the firing is done which is determined by the skill of the firemen and also in the case of a stoker by the type of stoker. The efficiency of heat absorption will depend on the firebox temperature, on the relation of firebox surface to flue surface and on the length and diameter of the flues.

It will be seen that the equations proposed by Mr. Poperev leave out of account a number of factors of major importance and can, therefore, hardly claim to be based on fundamentally correct principles.

LAWFORD H. FRY.

Another comment on evaporative capacity

CHICAGO, ILL.

TO THE EDITOR:

The only reliable literature on the subject of locomotive boiler evaporation is based on testing plant or standing tests, during which all factors entering into the test can be ascertained in weight or measurement by accurate apparatus and handling. So-called tests made on the road are of the roughest approximation of accuracy, due to the exigencies of service and the complication of the mixing in of the engine and the auxiliary appliances, steam requirements and performance. Locomotives, however, are not built for testing plant service but for road service, which may account for the numerous and varied tests made.

In Mr. Poperev's article on the evaporative capacity of locomotive boilers which was published in the August and September issues of the *Railway Mechanical Engineer*, the formulas all contain constants based on "given" boiler and fuel. Fuel variations are bad enough. I was at one time an officer of a railroad on which the finest steam coal mined in this country was handled in vast quantities, yet we had so-called "bad coal failures" as on other roads.

The dimensions and arrangement of the boilers under consideration are likewise under "given" limitations, set up largely by the personal factors of the designers. The very important ratio of grate area to heating surface, as shown in Table 1, page 549, of the September issue, on a considerable number of locomotives, originated mainly on one road, ranged almost two to one.

The expression, "total heating surface" does not mean much; does not convey with any accuracy the heat transfer value per sq. ft. A large percentage of the flue and tube heating surface is of relatively low value. With a given firebox, one boiler may have 15-ft flues and another, due to wheel arrangement requirements, may have 20-ft. flues; but the five additional feet are of no real evaporative value, although taken in the formulas as of average value.

It is possible to find an equated value to cover the evaporation of tubes and flues for any length, size and spacing from fairly well established tables as used in locomotive design. If such values are deduced in terms of firebox evaporation and added thereto, it will give an expression of the real amount of heating surface on equivalent basis of evaporation for the boiler as a whole.

I also want to take exception to the omission of superheating surface in such formulas. The locomotive is a heat engine and all heat developed on the grates and the total heat as measured when steam is released for duty should be credited in the performance and expressed in the boiler efficiency. In a recently published test, the heat transfer across superheating surface was approximately 11 per cent of the total transfer of heat output to steam.

What has been said is not with the idea of evolving a formula, but to advance some practical considerations in boiler performance to assist the mathematicians in clearing up some debatable features of the constants employed.

C. A. SELEY
Consulting Engineer, Locomotive Firebox Company.

Encouragement from a reader

EL PASO, TEXAS.

TO THE EDITOR:

For several years I have been a reader of the *Railway Mechanical Engineer* and now want to express my admiration of the persistence with which you have tried to impress on the railway public the necessity and importance of apprentice training. As an apprentice and since finishing my apprenticeship, I have been interested in the articles appearing in your magazine on the above subject. They have been of a constructive nature at all times. The articles written by the apprentices have been particularly interesting in that they show that worth-while boys are taking an interest in their training.

To my mind, the biggest factor in apprentice training is to use the best judgment possible in hiring the boys. Then do the utmost in making finished artisans of them. So many times haphazard methods are used in choosing boys that it is no wonder that a poor-class of mechanics is the result. The returns paid on such an investment, in a boy in training, cannot be estimated and, from a selfish viewpoint it is incumbent on the railroads to give more time and thought to hiring as well as to training apprentices. ASSISTANT ENGINEHOUSE FOREMAN.

The making of a railroad officer*

FOR a long time there has been an insistent demand for a book on leadership, particularly directed or applied to the needs of the railway field. As the responsibilities of railway officers and foremen have increased and extended and the duties have grown more and more exacting, these men have been on the look-out for information that would help them to take advantage of the best thought on how they might improve their leadership ability. There have been hundreds of books and thousands of articles published in recent years on the art of management and personnel administration. These are rather high sounding terms for the busy foreman or officer who is constantly being crowded for results, who often has far more men under his direction that he should have according to the best practices, and who in many cases on a railroad has the forces scattered over a large area. Unfortunately most of these books and many of the articles have lived up to these high sounding terms, and it has been extremely difficult for the average man to study them with any great degree of enthusiasm, or, indeed, to profit much from them. Then there is a great group of younger men in railroad organizations who have been trying to find some way of preparing themselves for promotion.

A successful railroad officer who early recognized this need and who possessed more than ordinary powers of observation and had had unusual success both as a leader and in developing the men under him was finally inspired to prepare a book particularly directed to the needs of railroad officers, foremen and ambitious workers. While Mr. Woodruff, the author, clearly outlines the principles of good organization and successful leadership, it is not done in the usual text-book fashion, or in the cold formal manner adopted by writers of technical books. Rather, Mr. Woodruff has thrown into the book much of his energetic, enthusiastic, constructive personality and we find the statement of principles backed up by, or even included in, interesting observations and personal experiences. This makes the book easy to read and study.

The book covers a wide range, as is clearly indicated by the chapter headings which follow, but on the other hand it is accompanied not only by a complete index, but the table of contents includes under each chapter heading a comprehensive synopsis by listing the subheadings. Moreover, to facilitate reference, the subheadings are printed in bold face type, so that they can readily be located. The chapter headings are: Why This Book; Service; Co-operation; Study of Human Nature, followed by five chapters relating to the study of profiles, heads and other distinctive types; Differences Between Men and Women; Expression or General Appearance; Employment; Psychology and Memory; Job Analysis; Planning the Work; Organizing the Work; Treatment of Men; Cost Studies; Charting Statistics; Elimination of Emergencies; Safety; Public Speaking; Further Application of Salesmanship Principles; Ethics of Railroading; Staff Teamwork; and Personal Application.

In commenting upon the book and its table of contents the Railway Age recently said:

"These are only a very few of the subjects covered, but they are perhaps sufficient to give an idea of the range of the work. And the author bases all his principles and generalizations on definite instances which have arisen in his experience. This keeps the subject from soaring above the head of the literal-minded reader and also serves to make his recommendations specific. There will doubtless be differences of opinion concerning some of his statements, but if one should write a book covering this field and include in it only those principles on which there is general agreement, the book would be so elementary as to lose its value outside the kindergarten. Too many books dealing with the technique of various occupations have stumbled into this fault, and it is encouraging to see this author avoid it even at the expense of arousing some criticism on the part of those who will not agree with all his conclusions.

"But this quality makes the work of value to railroad officers who have already 'arrived'—persons who could not possibly be interested in it otherwise. These readers will look at the work not so much as an authority telling them how to succeed—they have already done that—but rather as a collection of intelligent observations and comments by one of their own kind, with whom they may differ as they see fit.

"Readers of this calibre—and probably many of the younger men too—will, we believe, question the length to which the author goes in placing his trust in the so-called 'science of character analysis,' whereby it is believed possible to lay down definite rules concerning the characteristics of men according as they are blondes, brunettes, high-browed or lantern-jawed, and so on. The author is perfectly honest about it and says in a footnote that the possibility of so arriving at an approximation of character is questioned. But even if it is possible to arrive at accurate conclusions from the observations of features, the fact remains that it is a task for experts. It is probably true to say that, other things being equal, blondes are thus and so. But other things are *not* equal. A skilled character analyst knows this and is careful to weigh all the factors obtainable, but even then his estimates are not always free from error. It is doubtful whether the author can successfully inculcate sufficient knowledge of the subject in his brief treatment of it to make his readers expert therein. They must, therefore, look upon his statements merely as introductory to the subject and await further study and richer experience before they begin dogmatically to judge their fellows with these rules."

A book of this sort can not only be read and studied to excellent advantage and profit by the individual, but it can also be used with good results for group study or in connection with club or open forum discussions and will undoubtedly find a large field of usefulness in this way. Mr. Woodruff has placed the railway world under deep obligations to him by recognizing and filling in so acceptable a manner one of the greatest needs of the present day.

*The Making of a Railroad Officer, by R. E. Woodruff, superintendent of the Erie Railroad. 244 pages, 5 in. by 7¼ in., bound in cloth. Published by the Simmons-Boardman Publishing Company, 30 Church street, New York. Price $2.00.

DURING THE YEAR 1924 the Canadian railways paid salaries and wages amounting to $239,864,265, a decrease from the previous year of over $13,000,000. The number of freight cars in service was 226,163 with a total capacity of 8,283,264 tons, or an average capacity of over 36 tons. Passenger train cars totaled 6,849. There were 5,857 locomotives in service, including 29 electric. The total fuel consumed was 9,307,372 tons at a cost of $51,279,428. The consumption of ties totaled 14,294,416 at a cost of $13,216,-325.34.

GOOD HEALTH PROFITABLE ALL AROUND.—Dr. M. R. Taylor (quoted at the National Safety Council convention at Cleveland) in discussing the stimulation of production, said: "The modern employer has come to realize that the human machine pays a far larger return on the investment in its upkeep than any piece of iron or steel ever can or will. Physical health is man's greatest asset; and as this is true individually, it must be true collectively; therefore, the capitalizing of it should become a consequential factor in all industries. A well-organized industrial medical department should be as beneficial to the employer as to the employee."

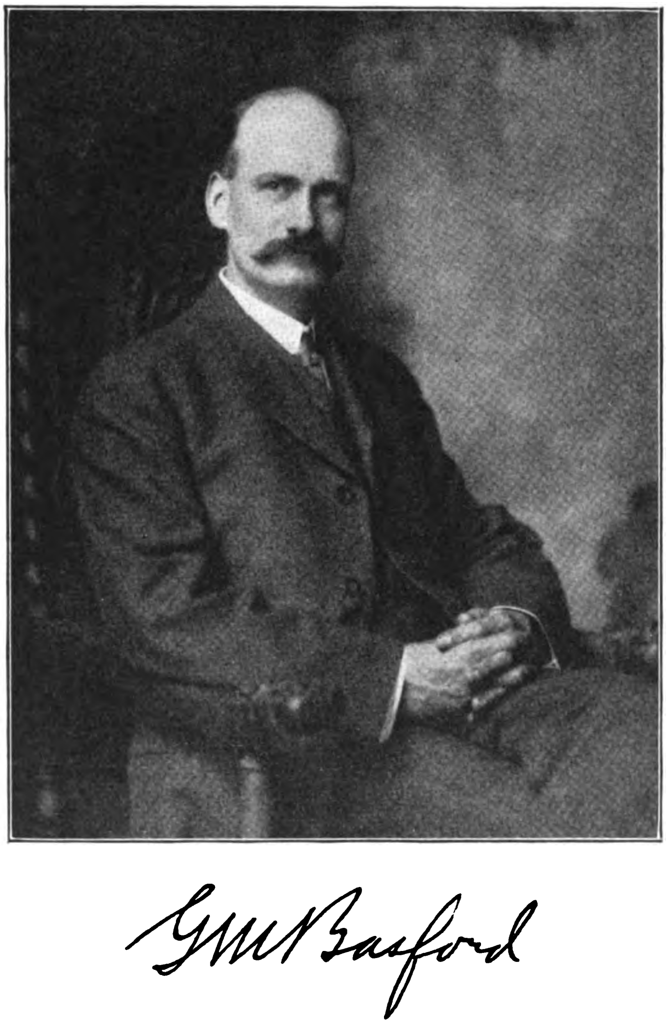
George M. Basford passes away

Former editor of this journal—Noted mechanical and signal engineer and technical publicist

GEORGE M. BASFORD dropped dead in the Jerome avenue subway station in New York City on Monday evening, October 26. Funeral services were held in Mount Vernon, N. Y., on Wednesday evening, and the interment will be at Boston on the return of Mrs. Basford from abroad.

During the early years of the present century this publication, then the American Engineer and Railroad Journal, was familiarly known among its readers as "Basford's paper." He was a fitting successor in its editorship to M. N. Forney, who had exerted so great an influence upon the upbuilding of American railroads. It is not surprising that the readers recognized it as "Basford's paper," because for a number of years he carried almost the entire burden of editing it, exerting a strong leadership in mechanical department affairs and gathering around him as counsellors the outstanding and most constructive men in the railway mechanical field. This significant statement was made when he laid down the editorship in the fall of 1905: "Mr. Basford has fought the battle of the motive power department, consistently and systematically maintaining that it should be properly and fittingly recognized because of its real importance in the organization of railroads."

The locomotive made a special appeal to Mr. Basford from his boyhood days, and without question he has had a larger influence upon the development of the modern steam locomotive than any other one man. Not that he ever patented or perfected any detail of locomotive design; but rather because of his keen engineering ability, and his vision and realization of the possibilities of the locomotive. He was constantly suggesting to the designers as individuals, or to the readers of this publication when he was an editor, what steps could best be taken to improve and develop it. He was, for instance, quick to recognize the possibilities of the application of the superheater, the Walschaert valve gear, the feed-water heater and many other special devices or new features of general design. He enthusiastically advocated such improvements in season and out of season and he encouraged designers and builders to experiment with them until they were finally perfected and came into general use. More than this, he recognized the importance of a larger utilization of the locomotive and did much to encourage the analysis and study of locomotive operation in order to determine just how this could best be accomplished.



For a few years before taking up editorial work he was a signal engineer and this experience and a study of the economics of signaling, led him to recognize in even a greater degree, the possibilities of a maximum utilization of the locomotives and track, resulting in more efficient and economical operation. Mr. Basford was always an enthusiastic advocate of railroad and technical associations because he recognized the inspiration and help that men receive from getting together and comparing notes and pooling experiences. "There is no reason," he used to say, "why an editor should not occupy a place of constructive leadership if he locates and keeps in touch with the leaders in specific fields. By getting around among these men, the editor, on the basis of their combined experiences, should keep ahead and be a great help to any one or all of them." It was a realization of the value of exchanging and combining experiences that caused him to get his fellows in the signal field to organize the Railway Signaling Club, later the Railway Signal Association, and now the Signal Section of the American Railway Association. He was familiarly known as the "father" of that organization and continued throughout his life to take an active interest in it, although in later years his work led him at times almost entirely into other fields of activity.

It hardly seems possible now that only a comparatively few years ago mechanical engineers felt that they were not concerned with questions of management and the human element; that their field was concerned more with materials and methods. Even in such an outstanding

organization as the American Society of Mechanical Engineers, it required a hard fight on the part of the more progressive members to have a consideration of these matters included in its program. Mr. Basford was among those who early recognized the importance of the human factor in industry and in the railroad service. He saw the railroads growing larger and more important, the cars and locomotives increasing in size and capacity and the problems of operation and maintenance growing more and more complicated, and was deeply concerned with the education and training of leaders who could maintain this progress and direct it along the right lines. He recognized the great waste of effort and energy caused by lack of adequate leadership and lack of training and education on the part of both the supervisors and the workers. The seriousness of this problem grew more and more on his mind and resulted in his paper on "The Technical Education of Railroad employees—The Men of the Future," which was presented at the American Railway Master Mechanics' Association in 1905. It was this paper more than anything else, that awakened the mechanical department officers to the necessity of giving greater attention to the selection and training of the workers. It was directly responsible for the inauguration of modern apprenticeship systems on the Santa Fe and the New York Central. It is doubtful if even Mr. Basford's most intimate friends understood the tremendous effort and the infinite pains that he took in preparing this treatise, submitting it before it was put into its final shape to many of the leaders in the railroad world at that time, including men like E. H. Harriman and James J. Hill. In commenting on this paper the Railway Age Gazette, now the Railway Age, said in its issue of March 14, 1913:

"The preparation of this paper might well be studied by young men who are ambitious to make their efforts felt in the railway field, and it affords a marked contrast to some of the papers and reports which are often presented before railway clubs and technical associations. It was the result of years of study of conditions on the railroads in this country and a practical experience in mechanical department work. Foreign methods had been carefully looked over on his trip abroad and then the whole scheme was carefully planned and outlined. The paper was then drafted roughly and was rewritten and rewritten until every sentence was carefully rounded out and every superfluous word removed, so that the thought was clear and forceful throughout. It was then submitted for criticism to a number of leading railway officers and industrial managers, and their comments were carefully considered in its revision, although it may truthfully be said that such revision as was made was very slight indeed. And dominating it all was a broad spirit of fellowship for his fellow man, which is so characteristic of Mr. Basford. It is little wonder that it marked the real cornerstone of railway apprenticeship education in this country, and it is to be regretted that more railroads have not adopted and lived up to its spirit."

Mr. Basford was constantly on the look-out for the opportunity of inspiring and helping promising young men, in order that they might better prepare themselves for making the best possible use of their talents. No sacrifice of time or energy was too great to make for those who called upon him for advice or assistance. The latch string of his office was always on the outside and there has been a constant stream of young men, and older men, too, going to him for advice and inspiration. He proved to be a haven in times of stress; indeed, at times when his personal problems were giving him the deepest concern and seemed to be about all that he could bear, he would be found temporarily laying them aside in order to help someone in distress. It is not surprising, therefore, that in 1903 a large number of his friends, realizing that he himself was greatly in need of relaxation and encouragement, united to send him abroad with his wife for a number of months. Even then he insisted on keeping in the harness and the valuable record of his impressions of foreign railway practice represented appreciation for the tribute that his friends paid to him.

It is difficult to recognize in a proper way the great influence which Mr. Basford had on raising the standards and value of the advertisements in the technical press. His long engineering and editorial service, his broad training and large vision, supplemented by experience in salesmanship, brought a new force to bear when he entered the advertising field. It is a far cry from the day when advertisers changed their copy only once or twice a year and ran little more than a card, to these days when advertising copy is changed in every issue and advertisers go to great expense to secure that kind of copy which not only possesses a strong educational value, but specifically aims to give the possible user of the device or material accurate information about the functioning of the device and how it may best be utilized, with concrete information as to its advantages. Mr. Basford's ideal was to rival the editor in making the advertising pages so instructive and interesting that the reader would turn to them first on opening his paper. That he and others who caught this same vision have achieved a large degree of success, is widely recognized.

Mr. Basford was constantly being approached for advice by officers and subjects committees of the different railroad associations and clubs, and not a few programs of the most successful conventions and club meetings have been due to the help that he gave, remaining, however, usually in the background. The records of these organizations over a period of years contain a considerable number of his addresses, every one of which was prepared with the greatest care, being presented only after he had painstakingly revised and reviewed them a number of times.

Mr. Basford was born in Boston in 1865, where he attended the public schools. He was graduated from the Massachusetts Institute of Technology in 1889, after which he entered the Charlestown shops of the Boston & Maine, later going to the Chicago, Burlington & Quincy as a draftsman at Aurora, Ill. He left the Burlington to take a position in the motive power department of the Union Pacific, and was connected with the test department of that road for some time, after which he entered the service of the Chicago, Milwaukee & St. Paul as signal engineer. Later he was superintendent of construction of the Johnson Railroad Signal Company, was with the Union Switch & Signal Company for a short time, and then became signal engineer of the Hall Signal Company. In 1895 he became mechanical department editor of the Railway and Engineering Review, and in 1897 was made editor of the American Engineer and Railroad Journal, now the *Railway Mechanical Engineer*. In September, 1905, he was made assistant to the president of the American Locomotive Company. It was during this period that for a number of months he was called upon to give part of his time in helping to start the Railway Business Association, rendering exceedingly effectual and much appreciated service. In March, 1913, he became chief engineer of the railroad department of Joseph T. Ryerson & Son. Mr. Basford organized the G. M. Basford Company to handle technical advertising in March, 1916. At about this time he was also made president of the newly organized Locomotive Feedwater Heater Company and headed it for several years until it was taken over by the Superheater Company. He was also consulting engineer of the Lima Locomotive Works, Inc.

"Bill Brown" and "Top Sergeant"

"Bill Brown's" policies and the editors of this publication are both severely criticized

THE *Railway Mechanical Engineer* had no idea when it announced the competition on the responsibilities and opportunities of the foreman that it was going to start a lively controversy, the participants in which would not be too busy in their efforts to belabor each other to toss a few brick-bats at the editor.

A few days before going to press we received a letter from the head of one of the mechanical departments as follows:

"There is a Scotch couplet that goes something like this:

'O wad some power the giftie gie us,
To see oursel's as other's see us!'

"With this thought in mind, I am attaching a copy of a letter sent me by one of our inspectors. It is interesting in more senses than one, but as it furnishes food for thought to the editor of the paper presenting the prizes, it has occurred to me it would be of special interest to you."

The article which accompanied the letter gives "Bill Brown" as well as the editors something to think about. We can see "Bill" grin as he reads the following extracts from this letter—or possibly he may be getting worried over some of the things that are being said about him.

Ridicules "Bill Brown's" article

"In the first place, were the article of intrinsic worth, surely a *nom de plume* would not be considered necessary. That in itself proclaims its greatest weakness and creates a doubt in my mind as to the genuineness of "Bill Brown."

"*The new foreman.*—Today in most shops time is figured out down to the fraction of a cent and the opportunity for calling all the men away from their respective machines for no other reason than to say, 'I have been made foreman' and to offer excuses—as one might reasonably interpret 'Bill's' remarks—is hardly to be expected. When a man is made foreman, be he stranger or otherwise, his actions from the start should be his introduction to the men. Let him realize that he is but one step ahead of the journeyman under him. It does not always follow that to be a successful foreman one must be the best mechanic; other qualifications just as important are very necessary and possibly it was for these he was chosen. The journeyman's ideas are often best and should be considered. I will agree with 'Bill' that the day of the hard-boiled driver is past. He was an abomination and his real efficiency was usually a minus quantity. The educational standards of our country today are such that the average mechanic is usually found to have a high grade of intelligence and as such should be respected. 'Bill Brown' by his patronizing tone would seem to ignore this point.

"*Keep posted about railway affairs.*—In his article 'Bill' surely allows his fancy to take a wonderful flight. He says, 'Give half an hour each night to the columns of *Railway Mechanical Engineer* and the Railway Age and he will become fairly well posted on such all-important subjects as operating ratios, fuel saving, taxation, rates, etc.' The idea of a machine shop foreman becoming fluent enough to discuss in an educational way the above topics and staying a mere foreman when such a knowledge of any one of them would offer its possessor a salaried position far in excess of 'Bill's,' is hardly understandable. I doubt very much if one could assimilate all this knowledge from periodicals. I feel that to devote a half hour each evening to furthering one's knowledge of his own particular brand of the work would be productive of greater results, not only to the employee, but also to the employer. Periodicals make light reading, interesting too, but as a usual thing eventually forgotten. As for the advertising columns, the maker and vender of each article claims its superiority over all others and to obtain an education through these channels would be out of the question. That was a rare flight of 'Bill's.'

"*Treatment of new employees.*—The new man is, as a general rule, anxious to make good, and I agree that his ultimate success lies in no small measure with his immediate foreman. The cost of labor turnover in some of our large shops is excessive and can only be written off by the employers as a total and, in the majority of cases, unnecessary loss. A proper study of human nature and the ability to strengthen the weak points of the new man, and place him where he is best fitted, would do much to lessen this item of expenditure and enhance not only the foreman's value, but also that of his men, in the eyes of the employer.

"'Bill Brown' mentions the fraternal pin. I disagree with his views on this. Experience has shown the writer that it is best to keep fraternal 'pull' out of a business such as 'Brown's.' Fraternalism and all it applies is one of the finest principles of our everyday life, in its proper place, and that to my mind is after working hours. To countenance any one 'pin' in the shop is to drive a wedge in your armor by the opposition, which is always to be found, and a consequent reduction in the general efficiency of a shop is the result.

"*New tools or machinery.*—When 'Bill' wrote this article his fancy was in the clouds, only to come to earth long enough to boost the *Railway Mechanical Engineer* and its advertising columns. He stepped blithely into the shoes of the master mechanic or superintendent and declared it most inexcusable for any foreman not to do so. A nice dream, but certainly neither practical nor educational.

"*The sales engineer.*—I will agree with 'Bill' that very often one can learn pointers from the sales engineers. More often than not they are practical men who have had shop training. One point, however, I cannot let go. He states that he has often been obliged (gladly) to work extra hours because of having spent some of his time during the day investigating their claims of devices. This statement sounds weak. In the first place, as a foreman, he was neglecting his duties during the working hours. Second, it is my belief that the average sales engineer is physically unable to carry around working samples of his wares.

"*Attitude toward apprentices.*—In part I agree with 'Bill' here. He is inclined perhaps to be too big-hearted, but a study of the human element would have to be the foreman's guide. No set practice can be employed.

"In summing up the entire article, I feel that 'Bill Brown' has hardly propounded any really practical views as to the duties of a foreman, but rather he has skimmed airily over these responsibilities with what is merely a

treatise on etiquette as he thinks it should be practiced in a machine shop, without giving thought to some of its impossibilities. The field of foremanship, especially with railroads, is too broad to be narrowed down within 'Bill Brown's' evident limits and it is hard to understand why a periodical of the status of the *Railway Mechanical Engineer* should laud and broadcast his views as being an outstanding example. Its paucity of detail, its impracticability, serves but to create an attitude of condemnation and doubt as to the article's veracity."

A more constructive letter—from a reformed member of the so-called hard-boiled group, at least so he characterizes himself—follows. Incidentally it tells why some supervisors are of the hard-boiled type.

Why some foremen are hard-boiled

CHICAGO, Ill.

To the editor:

It is gratifying to a lot of us old time foremen to see the interest being taken in trying to provide better opportunities for us, and to bring to us a greater realization of the importance of our positions.

I believe the generous response to your request for a free expression of opinion regarding the controversy now being waged relative to the divergent viewpoints of "Bill Brown" and "Top Sergeant" have opened the eyes of many to the fact that a great many foremen are and have been devoting much thought to this subject.

Personally I have been a most interested reader of all the articles which have appeared and while agreeing in the main with the stand taken by "Bill Brown," I can't help having a sort of sympathy with the "Top." Having started as a foreman thirty years ago, about the same time as he did, and presumably under similar environments, I can well appreciate why he is so hard-boiled. Years ago, especially in the part of the country where I was made, it was the rule to be hard-boiled. I was about as hard-boiled as they make them, and continued that way many years until I woke up to the fact that more and better work can be gotten out of men by leading instead of driving them. "Top Sergeant" don't seem to have learned that lesson yet. Maybe the "old dog don't want to learn new tricks."

In this day of enlightenment if a man in a supervisory capacity is hard-boiled, there must be a reason for it.

I started out, as I have no doubt "Top Sergeant" did—and as most foremen do when they are first promoted—with a very exalted idea of the things I was going to accomplish. I was going to show the "Big Boss" that never before in the history of railroading had a job been handled as efficiently as I would handle mine. I was going to be absolutely fair to all the men and give each one a square deal. I was going to so organize my work that none of it should lag behind on account of any lack of foresight on my part in ordering material or routing the various operations. I was going to be a real "humdinger." But I soon had many of my exalted ideas taken out of me.

My first job as a foreman was in a round house where I was compelled to handle about three times as many engines as we had stall room or facilities for handling. I had over double the number of mechanics, with their helpers and laborers, that any one foreman could handle efficiently. In addition to this there was no up-to-date machinery and very poor store room service. But regardless of these handicaps, I was optimistic and felt that I could deliver the goods.

After spending many hours at home when I should have been sleeping I matured a plan that looked mighty good to me. It called for a slight rearrangement of working force—adding a few mechanics and cutting off some laborers. I wanted a different arrangement of the tracks in the "garden" so that I could better handle the reserve power. I wanted a couple of new machines and a better supply of stock so that I could make and put into use some home-made tools that I felt would expedite the work. So many years have elapsed that I don't remember all the details of my plan, but I have a distinct recollection that if allowed to put my ideas into effect, I felt that our costs could be cut very materially.

Why I became hard-boiled

Full of hope and optimism, I put my ideas up to the "M.M." He was one of the old school of railroad officials who had forced his way up the ladder more by virtue of an aggressive personality, than by any real mechanical knowledge, but I had full faith in my ability to make him see the value of my suggestions. He read my carefully prepared plan over to the end. Then cocking his cigar at a more aggressive angle in the corner of his mouth, and glaring over the top of his glasses at me, proceeded as follows:

"What the h—— do you think I am, a fool? After handling the work at this point for ten years under the present line up, do you think I am going to confess to the management that we need to spend all this money for new equipment?"

"But, Mr. Jones, I thought—"

"To h—— with you, and your thoughts. I am hired to do the thinking around here. What's the matter with you? Can't you handle the job? If you can't, I'll damned soon put some one there who can. Get the h—— out of here now and get back into the round house and see that those men keep busy. If I catch any of them loafing on the job, I'll send you 'down the track talking to yourself'."

I needed that job. I realized that if I got fired my clearance would show lack of ability which would make it hard for me to get another chance. I went back into the round house determined to show the master mechanic, that if he wanted the job run the way it had been running, by hard-boiled, driving tactics, I was the man who could do it.

I must have succeeded after a fashion, for I was not fired. On the contrary, I gained the reputation of a hard, driving taskmaster, who would stand for no fooling. Later I was promoted to a somewhat more responsible position, so I was forced to the conclusion that my methods, if not of the best, were at least in accord with the popular ideas at that time.

I have never succeeded in building myself up to a real position in the railroad world, and as the years have passed I have more and more come to the conclusion that my methods have not been of the best. Regardless of the fact that I was driven by force of circumstances into a hard-boiled attitude of mind, I have always had a subconscious feeling that better work and more work can be gotten out of men by leading them than by driving. I have therefore welcomed the newer and better methods and have adapted myself to the present disposition on the part of the officials to exemplify the square deal in all relations with their employees.

I have gone into my personal affairs at length with but one object in view, and that is to point out the fact that if a foreman is hard-boiled, there may be an underlying reason for his mental attitude.

We will not be able to remedy conditions by painting beautiful word pictures typifying some super-foreman who possesses all the virtues and none of the faults of the rest of us poor mortals. If any of our foremen are hard-boiled, would it not pay to find out what their real or fancied reasons are for having that kind of a mental slant?

Inspiration must come from above

Why should it be necessary to preach the value of co-operative effort, education and the square deal to the foremen? Inspiration must necessarily come from above. Is it any less reasonable to think that the foremen would respond less quickly to such suggestions coming from their superiors, as they now expect the men to react to the teaching of the foremen?

Does not the very fact of the seeming necessity for such pronouncements to the foremen at this time constitute a serious indictment on the policies of their superiors in the past, and to some extent in the present? The foremen can go just as far and no farther than the stated policy of their company will allow. Like master, like man.

There are few foremen today who have not a full realization of all the advantages to be gained by following the policies set forth in the article by "Bill Brown." They don't need to be told those things. What they want is an opportunity to put them into effect.

They realize more fully, perhaps, than is generally suspected, that the first and greatest essential to success is a steady inflow of new knowledge that will better equip them in coping with their jobs. Very few of them get a chance to attend the conventions, and still less get an opportunity to travel around to observe the new methods in other shops, but all of them have an opportunity to subscribe to the technical magazines, and most of them do, Mr. Editor, or have done so at different times, until they have been satisfied that their efforts were futile. Personally I have received a great deal of good from reading the technical journals, but have seldom been allowed to put into use the many good ideas I have so acquired, on account of bumping into the "bogie" called "company standards."

What do they mean by company standards? Are they intended to be as unchangeable as the laws of the Medes and the Persians? Or should they be sufficiently elastic to permit of changing, if the occasion justifies? Should the foreman be instructed that these standards are inviolable, or should they be encouraged to figure out newer and better methods, with the understanding that they will be given credit if the changes are found acceptable?

Educational work must be directed

What effort is being made by the management of the different railroads to allow the foremen to present their side of the case? Are they encouraged to present their ideas in staff meetings or in articles? Is any effort being made to supervise and co-ordinate their reading to any practical end? Listen, Mr. Editor, let me give you an illustration of my meaning.

The field representative of your own paper, the *Railway Mechanical Engineer,* recently visited the shop where I work. He secured a subscription from every man of supervisory rank in the shop, as well as from a number of leading mechanics. He also sold a number of technical books. Before he left every man was provided with his text-books and had signified his willingness to study in order to be better equipped for his work. What was the result? No one to direct, supervise or co-ordinate their studies. No one to encourage them in applying the knowledge they may have secured, and no one of sufficient authority to permit of any changes of practice that might have been possible as the result of any knowledge so acquired. I don't believe your field man will have such good success here next year.

The railroads spend a lot of money each year in their safety campaigns. Good! It saves lots of lives and mutilated people as well as money for damage suits. They save lots of money by conserving coal, as the result of their fuel meetings. Why not spend a little money on an educational department that will direct and encourage the study that the foremen have signified their willingness to do, by virtue of having bought the necessary books?

Why not stop preaching at the foremen and co-operate with them in doing the things that they know, as well as you, are necessary to be done in order to ensure success?

JOE BUSH.

The foreman and his responsibility*

Emphasizes necessity for studying human nature and placing men where they can function to best advantage

By Zed E. Day

Gang foreman, C. C. C. & St. L., Beech Grove, Ind.

THE foreman has often been referred to as the "keystone in the arch of industry," and truthfully so, for as the keystone supports the arch of stone or brick, so does the foreman support and advance industry. His influence in this strategic point is felt by every individual connected with his organization, from the lowliest sweeper to the highest director. Since the foreman is such a vital part of the organization, it is well that he should take an inventory of his position and of himself and to come on speaking terms with his responsibilities and opportunities. The foreman is the one point of contact between the management and the worker; he acts as a representative for each. The manner in which he interprets the wishes of the management to his men forms the basis on which the men judge the management. Likewise the management will usually judge the workers by the way in which their problems and grievances are presented to them by the foreman.

It is within the foreman's power to make or break any rule, method, or process that it is desired to install, by the way in which he presents it to his organization. To the degree that he is for or against a proposition will it succeed or fail.

He is the one who organizes the workers—placing the right man on the right job; studying their characteristics; observing their strong points and their weak ones; helping them to overcome their weaknesses and to become of more value to the company. He is the one who knows and sympathizes with their problems, and instructs them in the

* One of the articles contributed to the competition on this subject.

most efficient manner of doing things. He is the one who arouses their interests to do greater and better things.

The foreman's principal job

His principal job is not, as a good many think, a matter of materials and machinery, but rather human nature. His chief responsibility is to study and know human nature, not only of his men, but also his own personality, so he will be enabled at all times to have proper control over the most essential element in industry—the human element—and at the same time have control of himself. Handling human nature is a battle and only fighters can win out in it.

Andrew Carnegie is reported to have said: "If I had to choose between losing my plants and equipment, or my organization, I would choose the former." Plants could be rebuilt and equipment furnished in a short time, but it would be the work of years to build another organization.

Since one of a foreman's main responsibilities is to organize his department, he should have a thorough understanding of the principles of organization. He must see that each man has certain duties for which he is held responsible, and that the man understands his duties and can carry them with a minimum of supervision. He must organize so that each little detail of his work is given to someone to perform regularly. He must learn to master detail—then learn to get rid of it. Too many responsibilities will break a man. The more details that can be taken care of successfully by others in an organization, the more time a foreman will have to do constructive work in improving methods and design. His advance in industry depends largely upon his organizing ability. This phase of his duties also presents a golden opportunity for mental development; he can experiment with men, the most intricate machine, by changing their duties occasionally, shifting them from one line of responsibility to another to ascertain their likes and dislikes, and to fit them in the right place. In doing this and observing his men he has the chance to learn the best way to organize, and will soon have a nearly perfect organization under his control. Great railroads, factories, steamships, telephone systems, and many other instances might be cited which are living monuments to organized forces intelligently directed.

Starting a new man

While the desire to produce more efficiently, and to eliminate waste is a paramount issue, it should not overshadow the need of training and the welfare of the worker. New men should be tactfully and judiciously dealt with, as their first impressions of a plant are likely to be lasting ones. Have a constructive talk with a new man to find out his aims and ideals, and inform him of the aims and purposes of the company, the quality of work expected; the location of the various departments; the natural progress of the product, and a general fund of good knowledge to give him his bearings on the job; an explanation of his assigned duties and their relation to the finished product. Finally invite him to feel free to ask any questions on anything he does not understand pertaining to his new work, and to make any suggestions for improvements in the plant that may occur to him. This policy will greatly reduce a tremendous waste due to labor turnover—a great problem in industry today.

The quality of the finished product is a responsibility which rests almost entirely with the foreman. He should familiarize himself with the quality of work expected and then produce nothing but work of that standard.

To the foreman who has vision enough to grasp these principles and apply them, I say his opportunities are unlimited. They will result not only in his advancement in industry, but also will he receive a great moral satisfaction which can result only in happiness and contentment in his work and in his life. This too, will make him worthy of his title, "The Keystone in the Arch of Industry."

Canadian National builds nine motor rail cars

Includes seven 60-ft. and two of articulated construction—Equipped with Diesel engines of light weight per horsepower

A NEW development in motor rail car design has been introduced by the Canadian National in the construction of nine Diesel-electric cars that are now being built at its Point St. Charles shops, Montreal, Que. Seven of the nine units are single cars having an overall length of 60 ft. and the remaining two are of the articulated type with an overall length of 102 ft. Including the articulated construction of two of the cars, the principal features in the design are the four-cycle Diesel engines and the use of three-passenger seats to obtain maximum seating capacity.

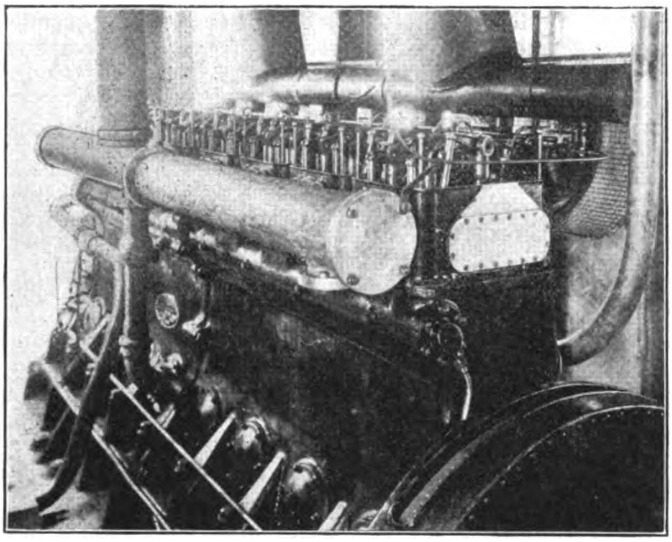
The engines

The engines installed in these cars were manufactured by William Beardmore & Co., Ltd., London, England. The design is a modification of this company's standard aeroplane engine which was changed to meet the service conditions of rail car operation. These engines conform to a modified Diesel cycle of the solid injection four-stroke cycle type and are arranged with four cylinders in line for the small unit which is used on the 60-ft. car, and eight in line for the large unit which is used on the articulated car. The cylinders in both engines have 8¼ in. bore by 12 in. stroke and develop 185 b. hp. at 700 r.p.m. in the small unit and 340 b. hp. at 650 r.p.m. in the large unit. The engine in the 60-ft. car weighs 2,750 lb. and that in the articulated car weighs 5,450 lb., or a fraction under 15 lb. per horsepower for the smaller engine and slightly more than 16 lb. per horsepower for the larger engine.

The low weight per horsepower was obtained through the selection of materials. The designers were able to reduce the thickness of the materials to a minimum through the use of high tensile steels and special alloys. For example, the crank case is of cast steel; the cylinder liners are made of forged steel; the cylinder heads, of

cast aluminum; the valve seats, of alloy steel; the pistons, of forged aluminum; the crank shaft of special forged alloy steel; the sump cover, of sheet steel; and the connecting rods, of special forged steel.

A feature in the design of these engines is the steel monobloc crank case, the upper part of which is bored out to receive steel liners, and thus form the water jacket around the liners. The main crank case casting carries the crank shaft bearings and also the base supports for bolting the engine to the underframe of the car. Large inspection doors are provided which give access to both end bearings. The lower part of the crank case consists of a light tray with an oil sump which is secured to the underside of the main casting. The main bearings are equipped with phosphor-bronze bearings lined with babbitt metal and are lubricated by a continuous oil pressure system. The connecting rods are made from special steel forgings, the top end bearing of which has a solid phosphor-bronze bushing, while the end is fitted with a pair of phosphor-bronze bushings lined with babbitt metal and fitted with an adjustable liner. Both bearings of the connecting rod are arranged for pressure lubrication.



The Diesel engine installed in the articulated car—It is of light construction, weighing slightly more than 16 lb. per horsepower

The pistons are made from forgings of a special aluminum alloy and are machined all over and balanced before finishing. Each piston carries four cast iron piston rings in addition to a scraper ring. The steel liners which are pressed into the main crank casing are also of light construction. The cylinder heads are made of an aluminum alloy and are provided with large spaces for the circulation of cooling water. Each cylinder head carries two exhausts, two valves and a central automatic spray valve as well as a compression release valve. The exhaust from each cylinder enters a manifold on the side of the engine for which one exhaust pipe for every four cylinders is carried vertically up through the roof.

The main crank case is a light steel casting and carries the housings for the ball bearings on which the gear wheel spindles run. Attached to the main gear case are the duplex lubricating oil filters, the oil pump and the centrifugal type cooling water pump, which is also equipped with filters.

Separate fuel pumps which deliver the fuel to the atomizers at from 8,000 lb. to 10,000 lb. per sq. in., are employed for each cylinder. A primary pump maintains an oil pressure on the suction side of the main fuel pumps. The injection is timed and the engine output is controlled by varying the effective piston delivery stroke. Any excess oil is delivered back to the fuel tank through a by-pass gear. A light residue oil of .86 specific gravity is used for fuel.

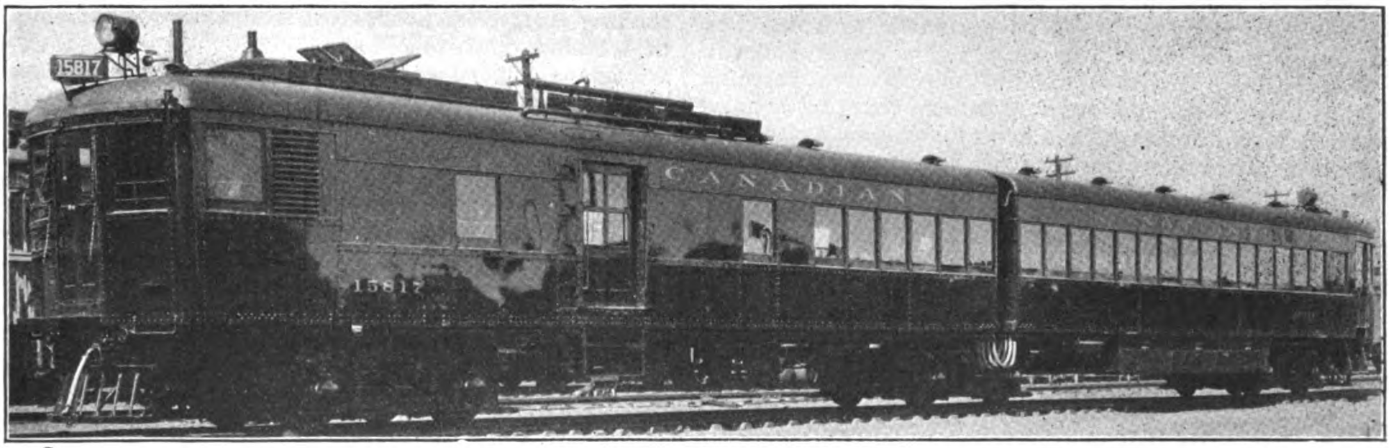
Engine auxiliaries

A centrifugal type governor driven off the crank shaft is coupled to the fuel pump control and is so arranged as to increase or decrease the oil supply to the fuel distributing system. It is fitted with an emergency device to cut the fuel pumps out of action should the r.p.m. of the engine for any reason be increased above the desired speed.

A centrifugal pump is used to circulate cooling water through the engine. This pump is mounted on the main gear case and can be easily detached for examination. Flow indicators are installed in the lubricating oil and cooling water circuits which indicate a stoppage of flow by lighting a lamp in the operator's room.

The tanks for water, fuel oil and lubricating oil are all made of 3/16-in. and ¼-in. aluminum plate and are located in the engine room. The piping is of aluminum, except in a few places where copper is used. The water tank on the 60-ft. car has a capacity of 120 gal.; the fuel oil tank, 75 gal., and the lubricating oil tank, 50 gal. On the articulated car the water tank has a capacity of 240 gal.; the fuel oil tank, 150 gal., and the lubricating oil tank, 100 gal.

Midwest air filters are applied to all of the cars for



Canadian National articulated Diesel-electric motor rail car

filtering the air supply to the engines. The filters used on the 60-ft. car are mounted on the ceiling of the engine room, while those on the articulated car are mounted on the left-hand wall of the engine room which is provided with shutter inlet to keep out the rain or snow.

The 60-ft. car has two full-size Rome Turney radiators mounted on the roof for cooling water and one half-size for cooling lubricating oil. The articulated car has four full-size radiators for cooling water and one full-size radiator for cooling lubricating oil.

The lubricating oil is forced under pressure to all working parts, including those of the cam shaft. Oil is drawn from the well in the sump, located at the gear case end of the engine, and is then forced through double filters via the cooler on the roof to the main supply tank. These filters can be cut out and cleaned while the engine is running. The oil then flows by gravity from the tank through a second pair of filters to the compressor pump which forces it through the crank shaft to the journals and pins and thence to the small ends at about 60 lb. pressure. A connection also leads to the cam shaft and oil is forced up through the center of the cam shaft to the bearings. Provision has been made to drain the unused oil in the engine back to the sump well.

The electrical equipment

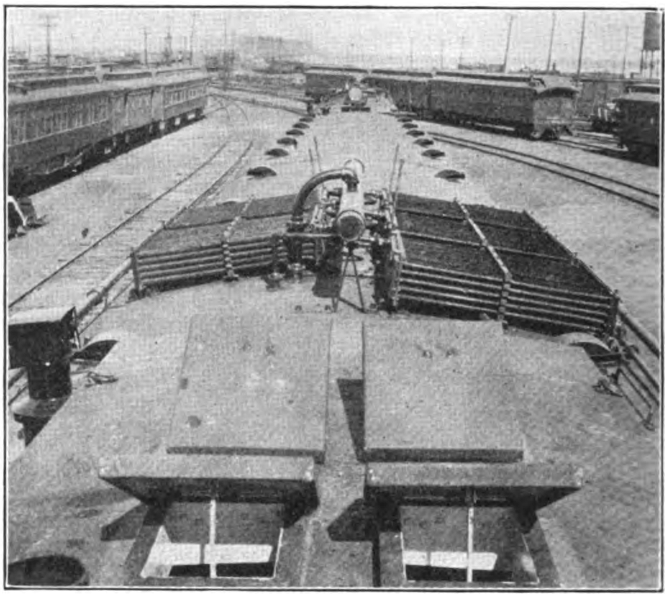
The electrical equipment on the articulated car was manufactured by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., and consists of a 200-kw., 600-volt d.c. generator mounted on a common bed plate with the engine and connected to it by a Fast flexible coupling. Pressed felt liners 1½ in. thick are placed between the bed plate and the car sills to absorb vibration.

The generator is differentially compound wound, the shunt field being excited from a 300-volt battery. The motors are 600-volt railway type 548-C-8, with a one-hour rating of 145 amp. connected permanently in parallel and mounted two on each of the front and rear trucks and connected to the axles by helical gearing.

The car is operated by master controllers located at each end, different speeds being obtained by a resistance control of the main generator field. Besides the master controllers, the main control apparatus consists of a switch group comprising eight electro-pneumatic switches, two reversers, an overload trip relay, and a sequence drum. The auxiliary control apparatus consists of a potential relay, an ampere hour meter, a battery charging relay, a field relay, a throttle valve, a control and reset switch and the necessary knife blade switches for the control of the several circuits. False operation of the various circuits is prevented by necessary interlocking between controls, which also makes the operation practically automatic.

The air for the magnet valves is taken from the air brake system and is maintained at about 70 lb. pressure, the electro-pneumatic control being the standard H.L. equipment throughout. The acceleration of the car is practically automatic as the control can be thrown to the "full" position, allowing the sequence drum to increase the generator voltage in four or five seconds. All controller positions are, of course, running positions, and lower speeds than the maximum can be obtained by intermediate points on the controller.

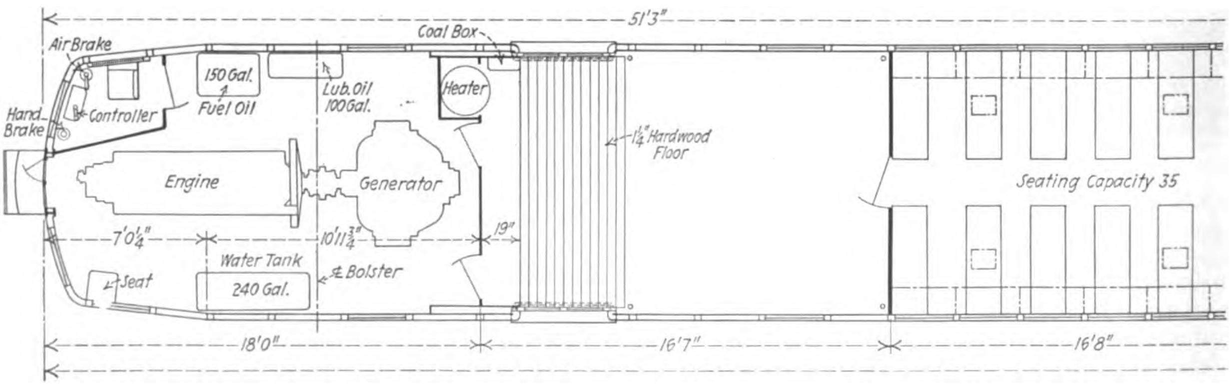
The engine is started by the generator driven as a motor, from the 300-volt battery, this starting position being obtained from the controller by moving the operat-



Top view of the articulated cars showing the radiators for cooling the oil and water

ing handle contrary to its operating direction. The engine starting position is also the battery charging position when the car is standing. By motoring the generator the 300-volt battery brings the engine to a speed of about 200 r.p.m. at which speed it fires on the first compression, the starting current for about two seconds being a maximum of 480 amp. down to 230 amp. at 150 volts. The battery voltage is applied to the generator through resistance steps and at the same time the engine throttle is moved by an electrically controlled air cylinder to full fuel position.

The battery is composed of 150 cells, M.V.A. 17 Exide Ironclad, and is located in two sections in steel boxes suspended from the floor of the rear half of the car. With the car running and the controller on either of the last



Floor plan of the articulated motor rail cars

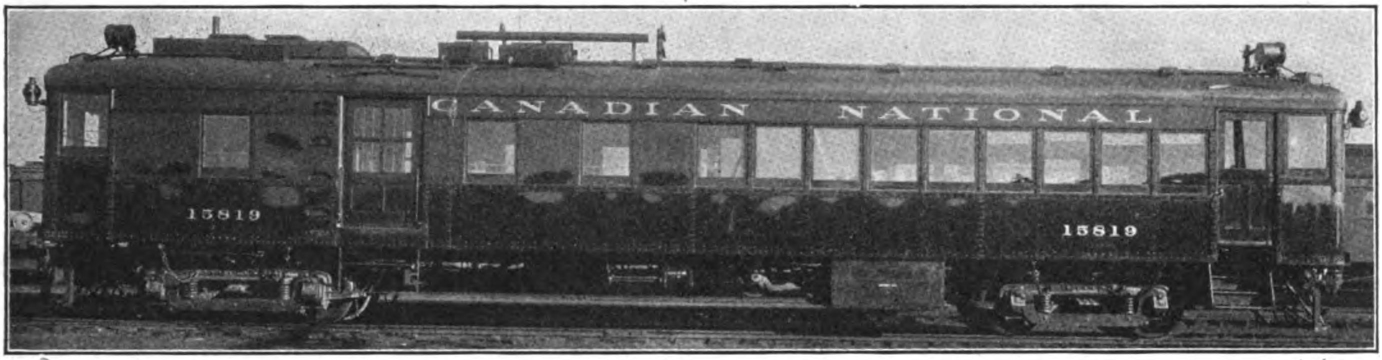
two notches, the potential relay cuts in and allows the generator current to charge the battery. This continues as long as the controller is on either of the last two notches or until the charging current is cut off by the ampere-hour meter.

Besides being used for starting purposes, the battery also supplies the control circuits at 30 volts; the generator field excitation at 300 volts; the two air compressors at 300 volts, and the car lighting at 30 volts. Low voltage circuits can be distributed over 90 of the 150 cells and standard lamp regulators are used to compensate for the charging voltage. Emergency switching is provided so that any of the 30-volt sections can be charged from the generator while the car is standing. One of the main reasons for having the 300-volt battery is that in case of necessity, owing to a total engine failure, the car can be moved on half voltage to the next siding, in order to clear the main line.

In carrying the circuits across the articulation, every effort has been made to secure accessibility and reliability. All the control wires are carried through the ceilings of the cars, terminating at each side of the articulation in junction boxes located in the car ceiling. The only heavy cables crossing the articulation are the generator bus liners to the motors, the battery line to the generator and the train line lighting circuit. By locating a reverser on each half of the car, the necessity of carrying the motor leads across the articulation is avoided. Multiple unit control has been installed so that two or more cars can be operated from any one operator's position.

The electrical equipment of the 60-ft. car was manufactured by the British Thomson-Houston Company, Rugby, England and the General Electric Company, Schenectady, N. Y. The generator, which was shipped with the engine from England, is a 105-kw., 600-volt d.c. differentially compound wound machine mounted on a common bed plate with and rigidly connected to the engine. Pressed felt liners 1½-in. thick are placed between the car sills to absorb vibration. On the same shaft with the generator is mounted a 6-kw. 60-volt exciter. The balance of the electrical equipment consists of two G.E. 240-A, 600-volt, 150-amp. (one hour rating) railway motors, mounted on the front truck and connected through helical gears. The controllers located at each end connect the motors in series, parallel or shunt field forward, and series or parallel reverse.

A 120-volt M.V.A. 17 Ironclad Exide battery is carried underneath the rear of the car. Thirty cells are suspended from the floor in a steel battery box on each side of the car. This battery furnishes starting current for driving the generator as a motor in a manner similar to that described for the articulated car, only 16 cells of which, however, supply the excitation of the exciter field and the car lighting. The 120-volt battery is charged from the generator by a special charging circuit used while the car is standing. The 32-volt portion is automatically charged by the exciter when its voltage is higher than the battery voltage.

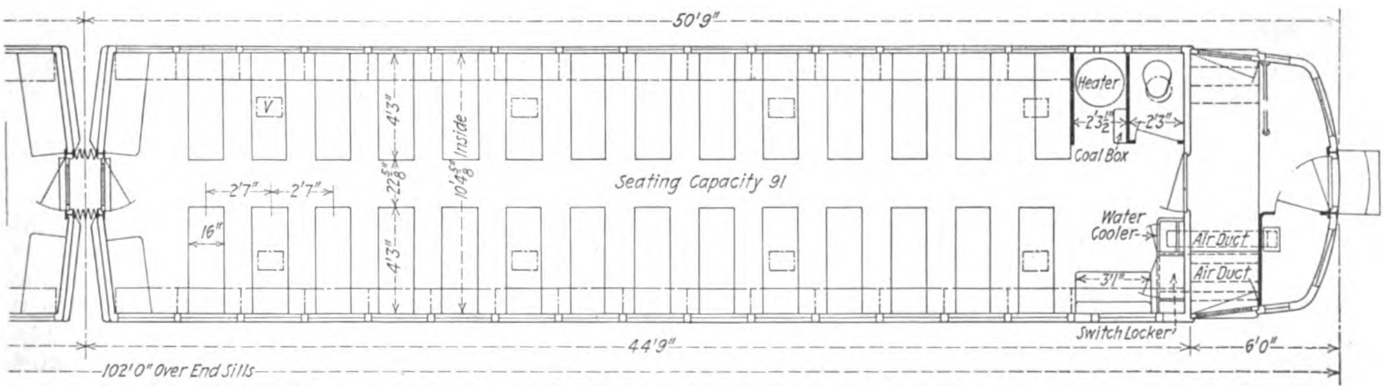


One of the seven 60-ft. Diesel-electric motor rail cars being built by the Canadian National

The car speed is controlled by the engine throttle, which is mechanically connected to an operating lever located in the operator's cab at each end of the car. The electrical controllers merely connect the motors to the generator circuit in series or parallel and are not used to operate the car. The first movement of the throttle lever closes the throttle relay switch, thus closing the exciter field circuit, and allowing the generator voltage to build up from zero across the driving motors. A further opening of the engine throttle increases the generator voltage and, therefore, the car speed.

Interiors of both types of cars are of similar design

The two types of cars contain many similar features of design and construction. The bodies of both the 60-ft. and the articulated cars were built by the Ottawa Car Manufacturing Company and are of steel construction throughout. The interiors are finished in mahogany and



recently placed in service by the Canadian National

have a 5/16-in. Agasote ceiling painted in cream color. Double floors are applied throughout with the exception of the engine rooms where a single floor 1¼ in. thick, covered with checkered aluminum floor plates, is used. The floor consists of one layer of 13/16-in. white pine and a top floor of ⅝-in. fir, with a double thickness of building paper between. The side lining below the windows is 5/16-in. Agasote painted to match the interior finish. Both types of cars are equipped with single windows of cherry, to which storm sash can be applied for winter use. Three-ply Salamander insulation is applied below the windows, two-ply above the windows and one-ply on the ceiling. The roof boards are of ½-in.

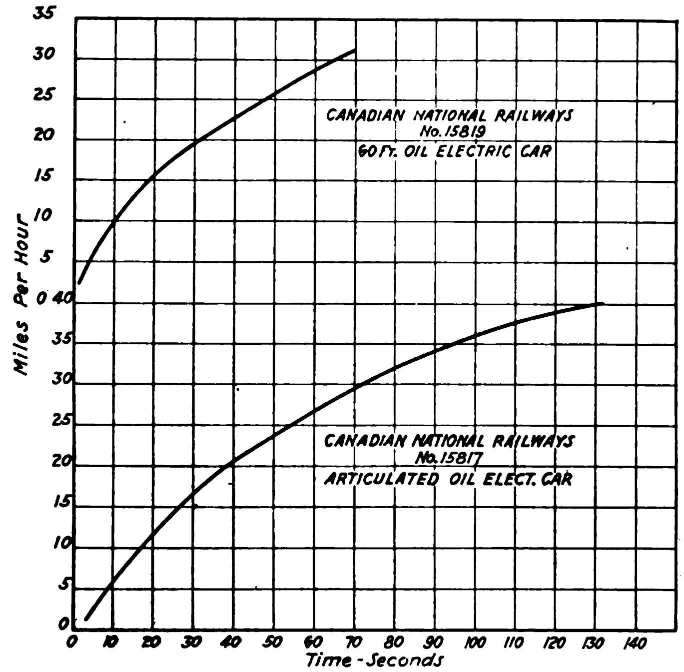


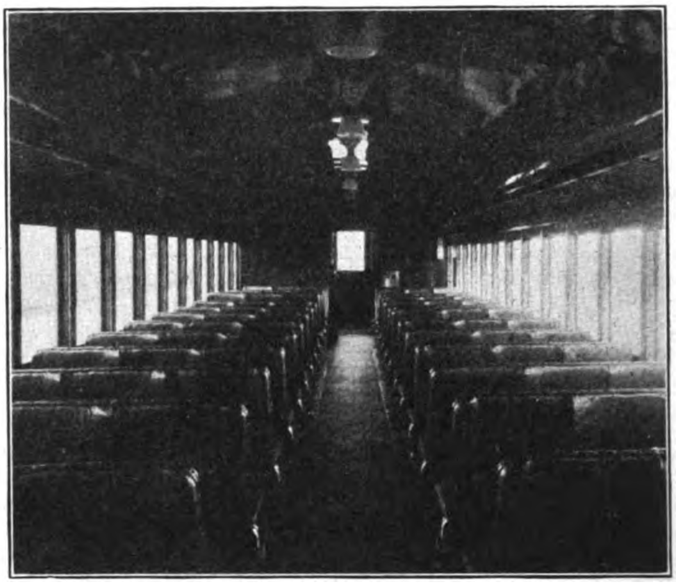
Chart showing acceleration curves for the 60-ft. and articulated cars on level track

whitewood covered with No. 6 canvas laid in white lead. Parcel racks running the full length of the passenger compartments are provided.

Electric lighting is provided from 30-volt storage batteries. Aluminum conduits for carrying the lighting circuits, power and control circuits are used throughout.

The articulated car has three-passenger seats

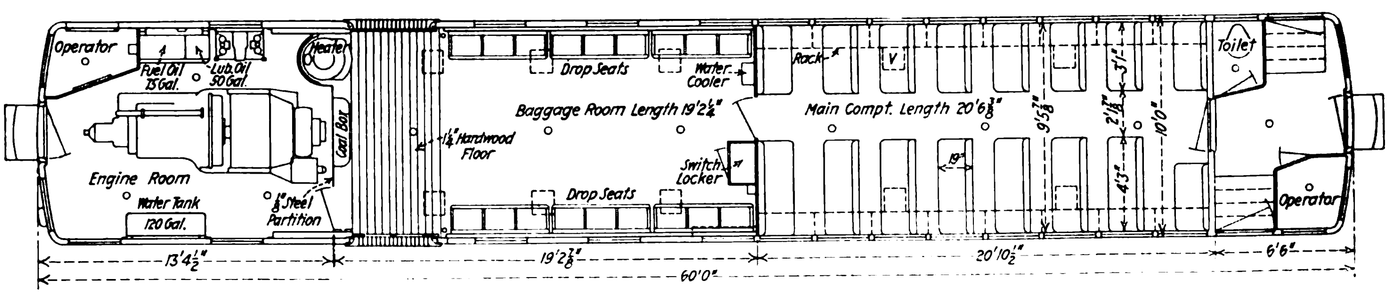
Each unit of the articulated cars consists of two bodies mounted on three four-wheel trucks. As shown in the floor plan of the articulated car, the front half contains the engine room, baggage room and smoking compartment which has a seating capacity of 35 persons. The



Interior view of the rear unit of the articulated car—The seats are designed for three passengers

rear half has a seating capacity of 91. The seats used in both compartments are of the Heywood-Wakefield reversible type, placed 2 ft. 7 in. center to center, and are upholstered in Spanish leather. Forty of the seats each accommodate three people while three seats provide for two passengers each, giving a total seating capacity for the articulated car of 126. The inside width is 10 ft. 4⅝ in. which permits the installation of seats 4 ft. 3 in. wide and allows an aisle space of 1 ft. 10⅝ in.

The length over the end sills of the front half of the articulated car is 51 ft. 3 in., and the length over the end sills of the rear half is 50 ft. 9 in. The overall height is 14 ft. 4⅜ in., and the width over the side sills is 10 ft. 10¾ in. The inside length of the engine room of the articulated car is 17 ft. 6 in., and the inside length of the baggage compartment is 16 ft. 6 in. The partitions



Floor plan of the 60-ft. motor rail car

Ventilation is provided by exhaust type ventilators in the roof. Smith hot water heaters are used for heating both types of cars. The 60-ft. car is equipped with one hot water heater which is placed in the baggage room. The articulated car has a heater located in the baggage room and one at the rear end of the passenger compartment. All of the pipes used in the heating system are of aluminum.

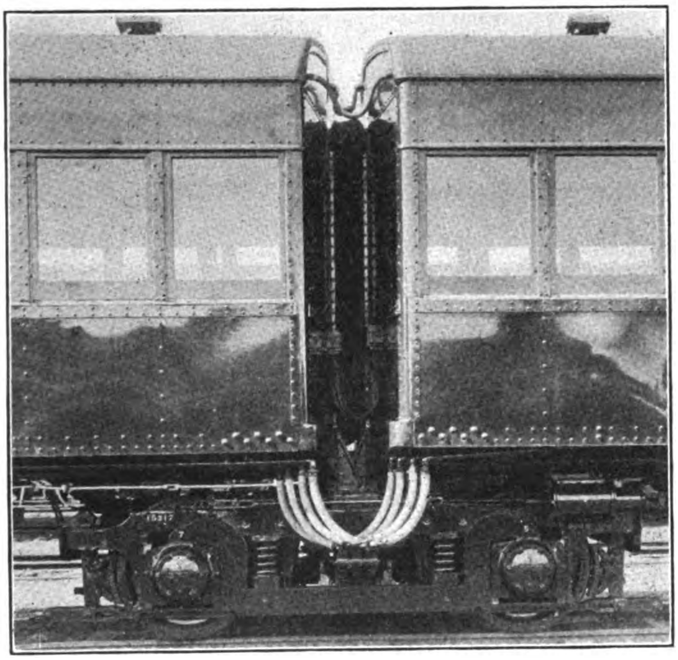
between the engine room and baggage room are of steel and are so constructed that they can be removed if necessary to work at the power unit. Roof hatches are provided directly over the engine and generator so that either may be removed by a crane for repair purposes. The hatch covers are provided with four ventilators operated from the engine room.

The three trucks of the articulated car are of Com-

monwealth design having 5-in. by 9-in. journals and 36-in. rolled steel wheels. The journals are equipped with S.K.F. self-alining roller bearings. Motors are mounted on the front and rear trucks only.

The center truck of the articulated car carries one end of both the front and rear body sections. Each section is provided with a special cast steel end sill to which are bolted center castings, one of which sets within the other, both engaging the truck center plate. A safety type locking pin is used, and safety bars are also provided. A one-piece canvas diaphragm encloses the space between the front and rear halves and a diamond steel foot plate is located at about the floor level.

The brake equipment is Westinghouse, schedule A.M.F. The air pressure on the articulated car is supplied by two DH-16 compressors connected in parallel. The braking ratios are based on 50-lb. cylinder pressure, being 83 per cent on the front and rear trucks and 75 per cent on the center truck. The trucks are equipped with the A.S.F. suburban type Simplex clasp brakes. The front and center trucks are fitted with a new design of brake which consists of a standard Type D freight brake cylinder mounted on each side of the truck frame and connected



Exterior view showing the center truck and connections between the two units of the articulated car

directly to the front brake gear. A flexible cylinder pipe connection is located near the center of the truck. On account of insufficient clearance, the cylinder for the rear truck is attached to the car body.

The sixty-foot car

The seats in the 60-ft. car are of the same design and manufacture as those of the articulated car. They accommodate three persons on one side and two on the other. In addition, the baggage room of this car is provided with drop seats of wooden construction giving a total seating capacity of 57.

The width over the side sills is 10 ft. which allows an inside width of 9 ft. 5⅞ in. The overall height is 15 ft. ¾ in. The distance between truck centers is 39 ft. 3 in. making a total wheel base length of 46 ft. 1 in.

Compressed air for the 60-ft. car is supplied by a General Electric CP28-D compressor. The braking ratio is 83 per cent based on 50-lb. cylinder pressure. The trucks are equipped with single shoe type brake with the standard body brake arrangements. They have 36-in. rolled steel wheels, A.R.A. boxes and brasses, cast steel side frames and built-up bolsters. The front truck carries two motors and has 5-in. by 9-in. journals. No motors are used on the rear truck which is equipped with 4¼-in. by 8-in. journals.

Both cars are equipped with the Universal Draft Gear Attachment Company's hand-brake booster and vertical operating ratchet handle. The standard train air communicating signal system is used.

A 12-in. Golden-Glow headlight is mounted on the roof at each end of each car. The Canadian National standard number lamps and Strombos horns are also provided, as shown in one of the illustrations. Miniere window cleaners are installed on the front window of each operator's room. Each car is equipped with a listening tube which runs from the engine room to the rear operating room. Sand boxes are suspended from the underframe and are filled through holes in the car floor. Hanlon sanders provide sand to the front of the front truck and to the rear of the rear truck.

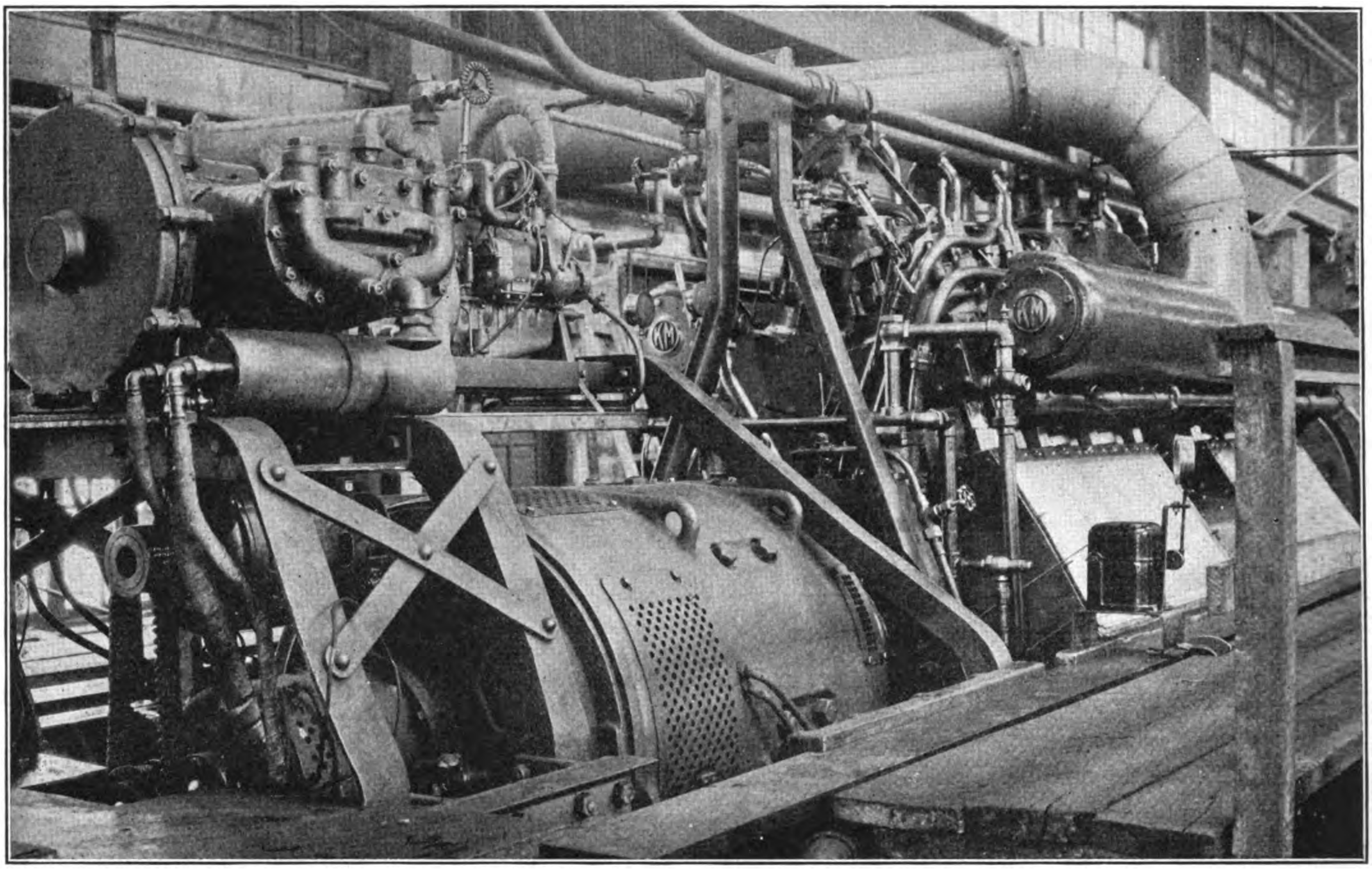
Principal dimensions and proportions of the Canadian National Diesel-electric cars

	60 ft. cars	Articulated cars
Builder	Canadian National	Canadian National
Type	Diesel-electric	Diesel-electric
Total weight	101,000 lb.	188,000 lb.
Total wheel base	46 ft. 1 in.	85 ft. 10 in.
Diesel engine:		
Builder	William Beardmore & Co., Ltd.	William Beardmore & Co., Ltd.
Type	4 cyl., 4 cycle	8 cyl., 4 cycle
Rated capacity	185 b.hp. at 700 r.p.m.	340 b.hp. at 650 r.p.m.
Cylinders, diameter and stroke	8¼ in. by 12 in.	8¼ in. by 12 in.
Weight	2,750 lb.	5,450 lb.
Generator:		
Type	Thomson – Houston, 105 kw. d.c.	Westinghouse 200 kw. d.c.
Voltage	600	600
Motors:		
Number	2	4
Type	General Electric Type 240-A	Westinghouse, 200 hp.
Capacity of fuel tanks	75 gal.	150 gal.
Length over couplers	60 ft.	102 ft.
Width, inside	9 ft. 5⅞ in.	10 ft. 4⅝ in.
Height, overall	15 ft. ¾ in.	15 ft. 4⅜ in.
Diameter of wheels	36 in.	36 in.
Size of journals	5 in. by 9 in., front truck, 4½ in. by 8 in., rear truck	5 in. by 9 in.
Total seating capacity	57	126

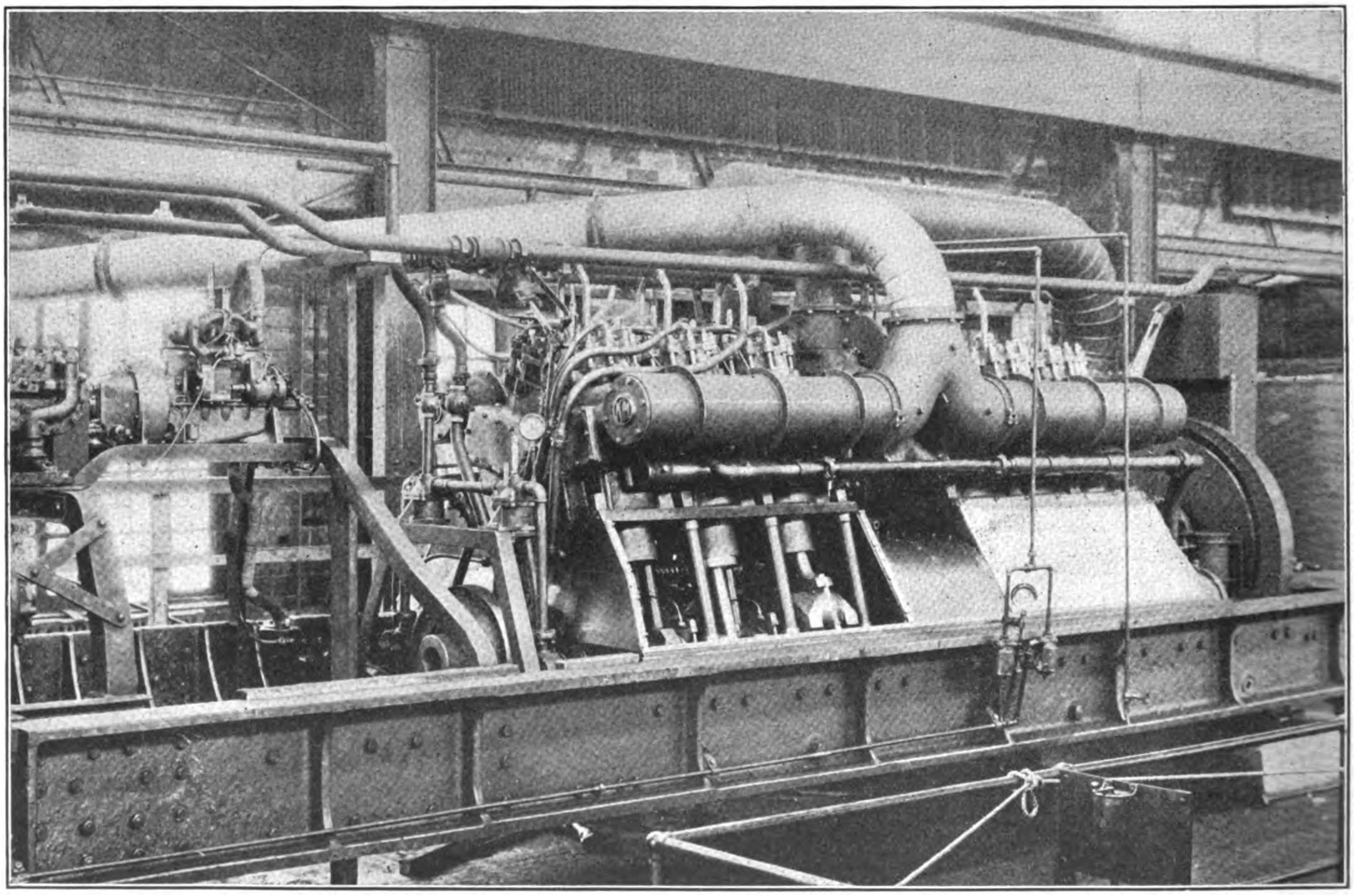
It is reported that both cars have attained a speed on level track of approximately 60 miles per hour and show a low fuel consumption. Both cars have sufficient power to handle a trailer over an average profile at a proportionally reduced speed. Car accelerations up to 40 and 30 miles per hour respectively have been made in actual test.

THE FEDERAL DISTRICT COURT for eastern New York holds that under the Boiler Inspection Act each day of use of a locomotive with a defective boiler is a separate violation of the statute.—U. S. v. L. I., 4 Fed. (2d) 750.

THE AVERAGE COST OF COAL for road locomotives in freight and passenger train service (charged to operating expenses) in May was $2.73 a ton, as compared with $3.07 for May, 1924, and $2.80 for the first five months of 1925, according to the monthly statement compiled by the Interstate Commerce Commission. The cost of fuel oil per gallon, however, was 3.24 cents as compared with 2.86 cents last May and the total cost of coal and fuel oil for the month was $25,880,953, as compared with $28,014,369 last May. For the five months' period the total cost of coal and fuel oil was $138,683,648, as compared with $160,251,663 last year.



View of the generator end of the power plant



View of the engine mounted on the cast steel girders, showing the scavenging air blower at the right

Diesel-electric locomotive built by Baldwin

The twelve-cylinder engine develops 1,000 horsepower—The rated maximum tractive force is 52,200 lb.

A DIESEL-ELECTRIC locomotive has been built by the Baldwin Locomotive Works, Philadelphia, Pa., which has the largest horsepower capacity of any internal combustion locomotive yet built in this country.

The rated maximum tractive force of the locomotive is 52,200 lb., the oil engine having a rated capacity of 1,000 hp. The total weight of the locomotive is 275,000 lb., of which 180,000 lb. is carried on the driving wheels. The total length over the couplers is 52 ft. 1¾ in. The locomotive has a total wheel base of 38 ft. 4 in. and a rigid wheel base of 12 ft. 8 in. The electric transmission consists of four Westinghouse type 353-D-3, standard railroad type, self-ventilating 200-hp. motors which are geared to the driving axles through flexible gearing. Power is furnished to these motors by a Westinghouse self-ventilating, direct current generator and exciter directly connected to the engine.

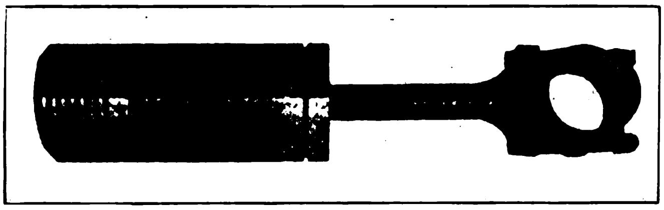
Referring to the illustration showing the side view of the locomotive, it will be noted that the general appearance is similar in many respects to that of an electric locomotive. The cab is of all-steel construction and extends the entire length of the frame. The height from the rail to the top of the cab is 14 ft. 7 in. and the width overall is 10 ft. 5 in.

The power plant of the locomotive is carried on two six-wheel trucks, each made up of the usual locomotive type bar frames in the pedestals of which are mounted outside journal boxes of three pairs of wheels. The two motors in each truck are geared to the outside axles, the middle pair of wheels running idle. The power plant, consisting of the oil engine, the direct-connected generator and the auxiliaries, is carried on two longitudinal cast steel girders which are connected by cast steel cross-ties at each end. These cross-ties also contain the center pins which engage the center plates of the two motor trucks. The drawbar pull is transmitted from one truck to the other through a drawbar and radial buffer construction at the inner ends of the two trucks, of a type commonly used in electric locomotive design.

A feature in the design of this locomotive is the arrangement of the spring rigging which has been patented by the builder. Two springs are placed over each box, one on the inside and one on the outside of the frame, each resting directly on top of the journal box and connected with each other by short cross equalizers at each fixed attachment to the frames. These equalizers allow for any variation in the height or deflection of the two springs which act together. Placing the spring alongside of, instead of over the top of the frame as would be required by the usual arrangement of one spring for each journal box, permits the lowering of the center of gravity of the locomotive at least six inches and also permits a corresponding increase in the headroom in the cab.

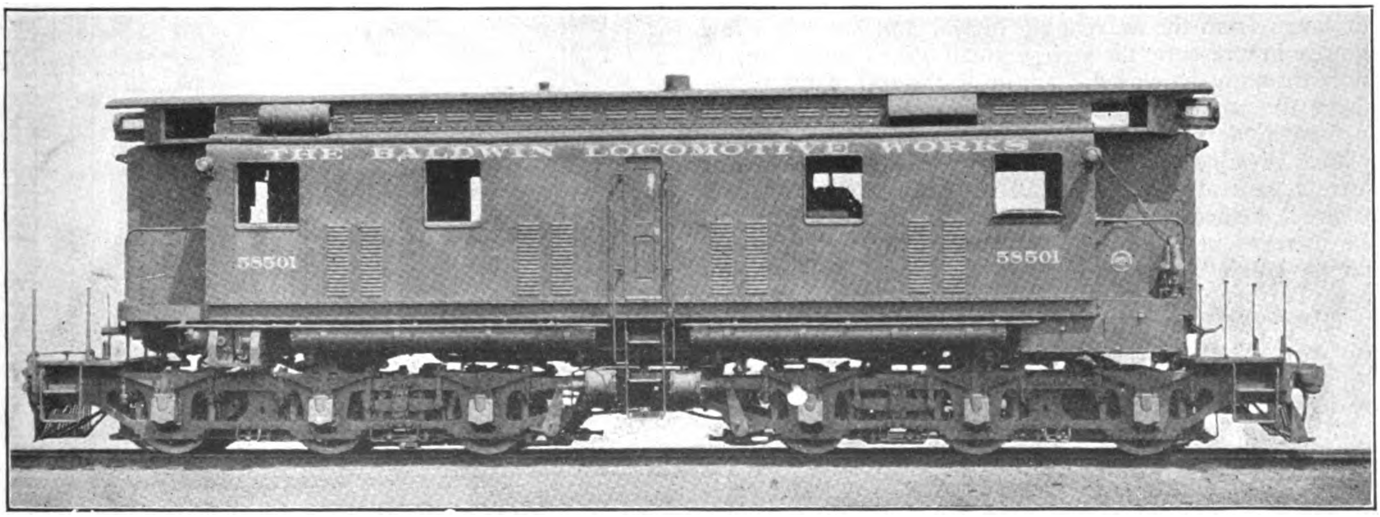
The Diesel engine

The oil engine, which is of the two-cycle solid injection type, was built entirely in the shops of the Baldwin



The head of each piston is provided with a long port to permit the entrance of air for cooling

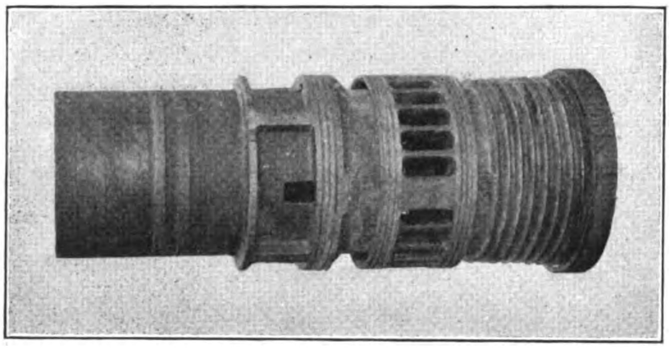
Lcomotive Works according to an arrangement with the Knudsen Motor Corporation, New York. There are twelve cylinders arranged in two groups of three pairs each, the pistons in the two cylinders of each pair driving on separate parallel crank shafts. Each pair of cylinders, however, has a common combustion space,



1,000-hp. Diesel-electric locomotive built by the Baldwin Locomotive Works

enclosed by a single head casting and supplied with fuel through a single injection nozzle. The six fuel pumps, one for each combustion chamber, are operated by a cam shaft. In the center of each of the two crank shafts, between the two groups of cylinders, is a large herring-bone gear, the gears from the two shafts meshing with a herring-bone pinion on the end of the generator shaft which steps up the crank shaft speed of 450 r.p.m. to 1,200 r.p.m. at the generator.

The cylinders, which have a diameter of 9¾ in. and a stroke of 13½ in., contain the ports usual in two-cycle internal combustion engines near the end of the stroke. The gears, which keep the two crank shafts in constant angular relationship, are so meshed that the pistons on one side of the engine are in slight angular advance in relation to those on the other side. Through the ports in these cylinders the exhaust takes place, to be followed by the admission of scavenging air from a manifold connected to the corresponding ports on the other side of the engine. The scavenging air thus enters through the ports in one cylinder and passes up through that cylinder, down through the other and out through the exhaust ports once in each revolution. On the return stroke the piston on the exhaust side of each pair of cylinders closes the exhaust ports slightly in advance of the closing of the air intake ports of the other cylinder so that scavenging air, which is delivered by a



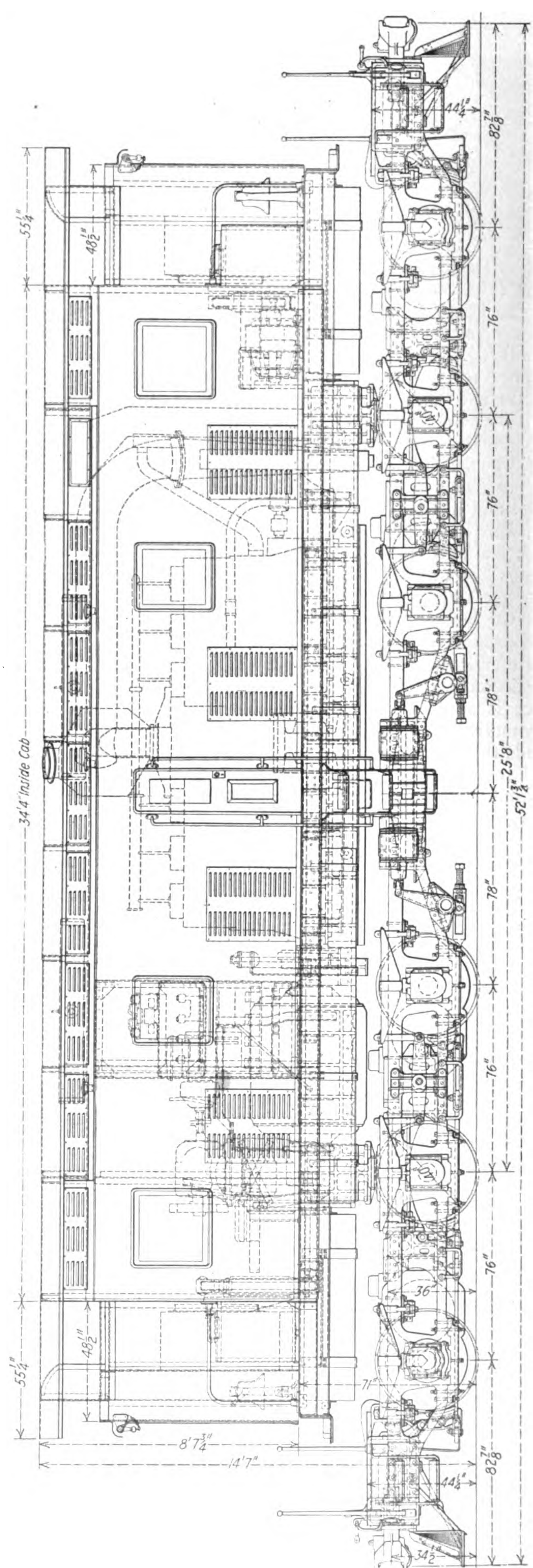
View of the cylinder showing the ports used for scavenging and for piston cooling air

blower at about 2½ lb. pressure, builds up to this pressure in the cylinders before the intake port closes and compression begins. In this way a degree of super-charging is effected which materially increases the amount of power that may be developed in a given cylinder volume.

Another special feature of the engine lies in the port openings in the cylinder and piston walls which permit air taken from the scavenging blower and boosted a few ounces in pressure through a small gear-driven fan, to blow through the closed chamber in the top of the piston above the wrist pin and mingle with the scavenging air in the cylinders, the purpose being to cool the pistons.

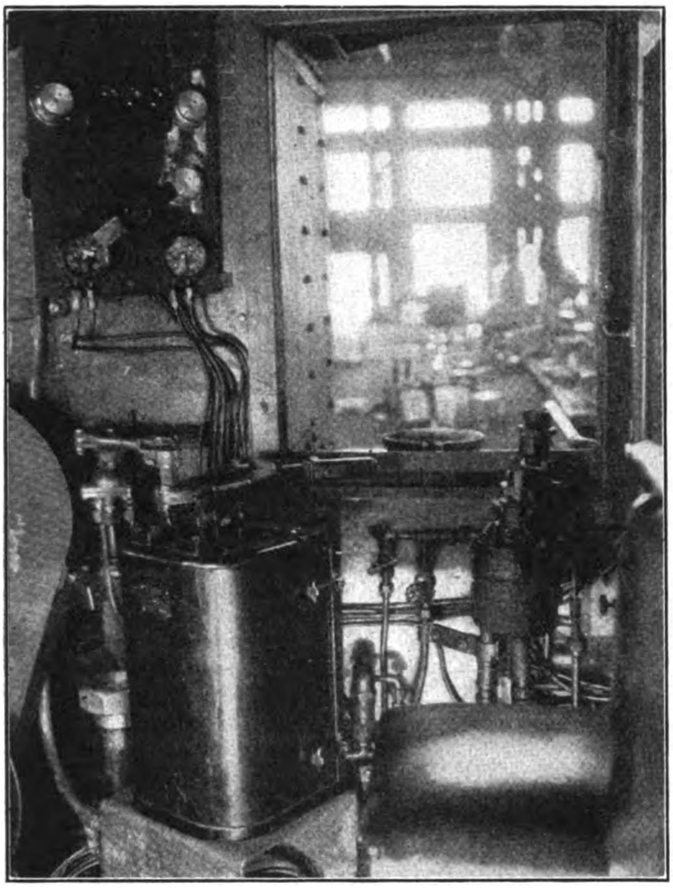
The Westinghouse 750-kw., separately excited, direct current generator develops 750 volts at 1,200 r.p.m., and is direct connected to the step-up shaft of the oil engine, the increase in the speed of this shaft over that of the engine crank shafts permitting a material reduction in the generator weight.

The principal auxiliaries which form a part of the power plant are the scavenging blower, the water cooling system and the air compressors. The scavenging air is delivered by a centrifugal blower which is driven at 3,600 r.p.m. by a gear connection to an extension of the generator shaft. This blower has a capacity of 4,500 cu. ft. of air per minute at 2½ lb. pressure. The water cooling system, which was designed by the Modine Manufacturing Company, Racine, Wis., consists of two radiators, one built into each end of the locomotive cab, the



Elevation of the Baldwin Diesel-electric locomotive showing the power plant in outline

water being circulated by a gear pump driven from the engine shaft. Air is circulated through each radiator by a fan, the fan at the front end of the locomotive being driven mechanically from the engine shaft, while that at the rear end opposite the generator is motor driven.



Interior view of the cab showing one of the control stations

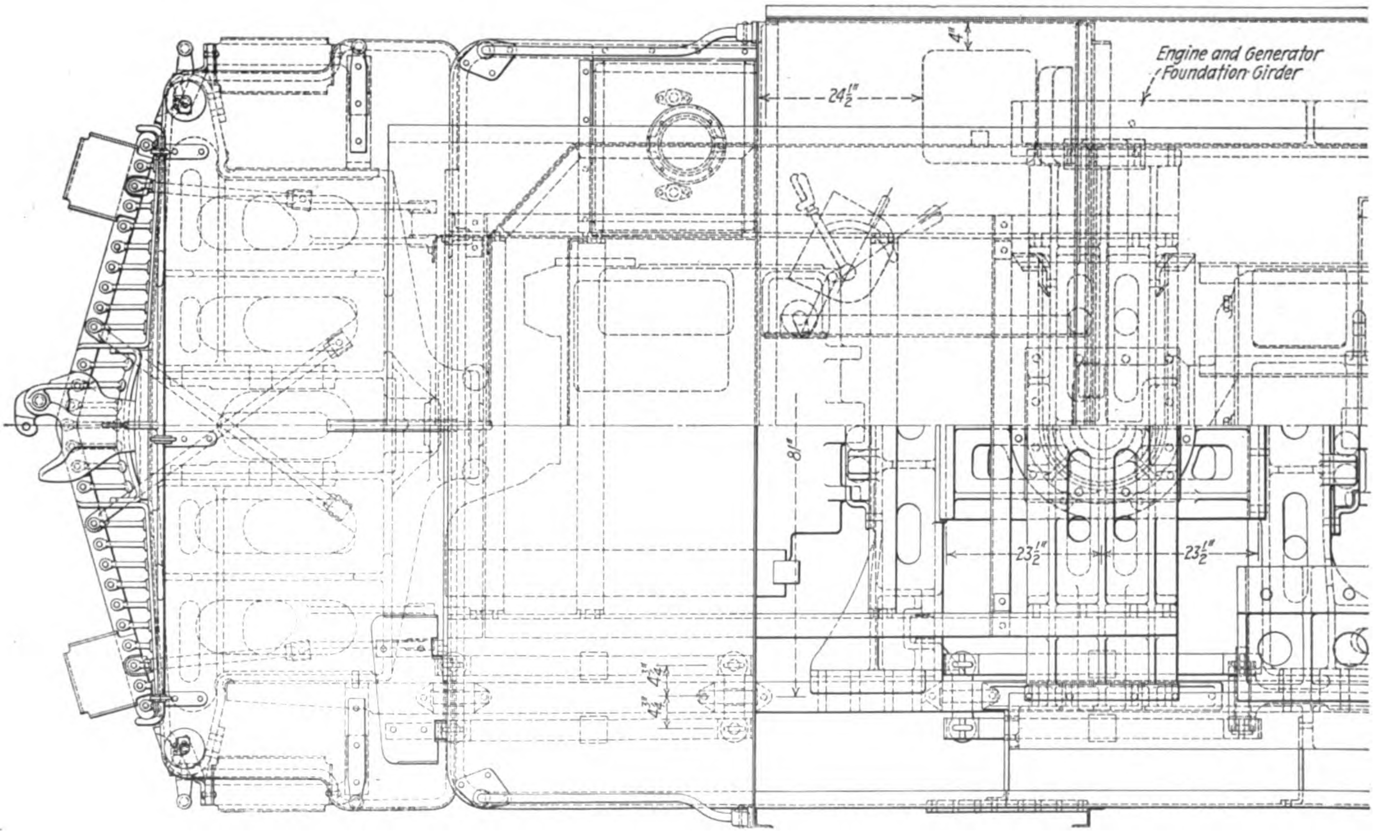
The locomotive is equipped with three Westinghouse motor-driven traction air compressors. One of these is suspended under the cab at each end of the locomotive, while the third is mounted in the cab over the generator. Connected by means of a clutch to an extension of the motor shaft of this compressor is a small four-cylinder gasoline engine which is used in starting the locomotive to build up a main reservoir pressure of about 120 lb. to supply air to turn over the Diesel engine the few revolutions required before combustion takes place in the cylinders. The gas engine is then declutched and stopped, the compressor continuing to operate as a motor-driven unit under the same automatic control as the other two units.

The starting system consists of six air distributing valves operated by the cam shaft, each admitting air to its pair of cylinders through a check valve in the cylinder head. A single throttle admits air to all the distributing valves when the motor is to be started.

The lubrication of the engine is a combination of the force feed and splash systems, the oil circulating pump being driven mechanically from the engine shaft.

The control equipment

The control equipment, which is of the Westinghouse electro-pneumatic type, is arranged for double end operation of the locomotive. With the Diesel engine and generator running at a constant speed, the locomotive is accelerated from standstill by the manipulation of a master controller, shown in one of the illustrations, by which the voltage of the generator is increased in steps, through field control, as the speed of the locomotive increases. With full generator voltage for a given generator speed developed in this way, further acceleration is effected by increasing the Diesel engine speed and, hence, the generator power output. The oil engine throttle is controlled by the manipulation of a valve handle on the master controller, which permits the increase or decrease of oil pressure in a cylinder, the piston of which, in moving out-



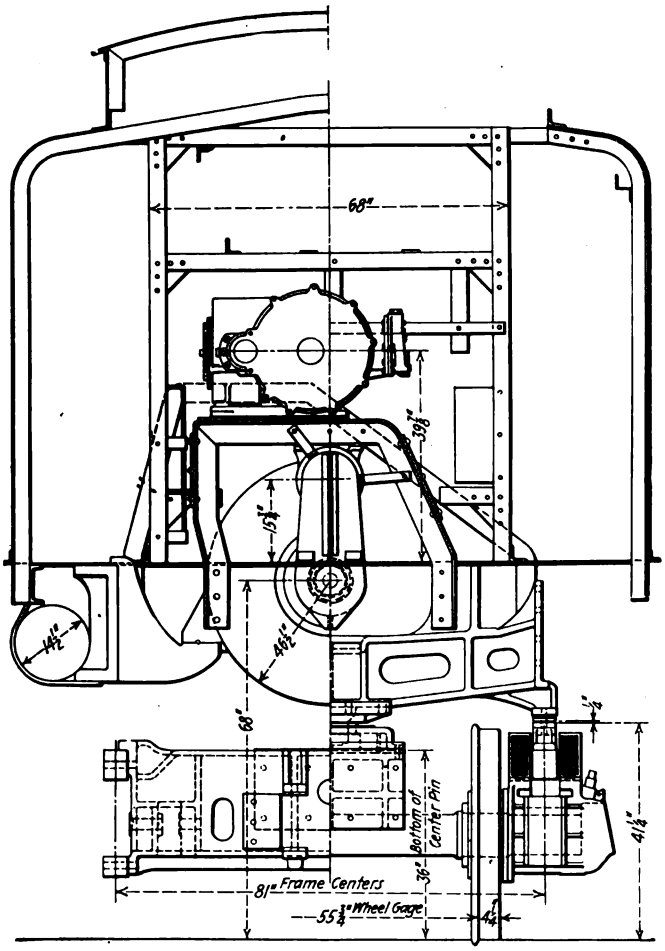
Partial plan of the locomotive showing the end construction of the power plant foundation

ward, compresses the governor springs. The throttle thus controls the speed at which the governor operates to reduce the stroke of the oil injection pump pistons. The unusual feature of this throttle control from the operator's standpoint, lies in the fact that it is manipulated to admit or release oil, supplied at constant pressure, to or from the control cylinder, only long enough to produce the desired engine speed, and is then brought to lap position until another change of power output is required.

Service trials

The locomotive, which was built in June, 1925, has for some time been in service on the Reading, part of the time in road freight service, between Reading, Pa., and Tamaqua, and part of the time in yard service. In both services the locomotive has given a good account of itself from a mechanical and power standpoint, the high tractive force characteristic of a constant power output machine adapting it particularly well to heavy switching service.

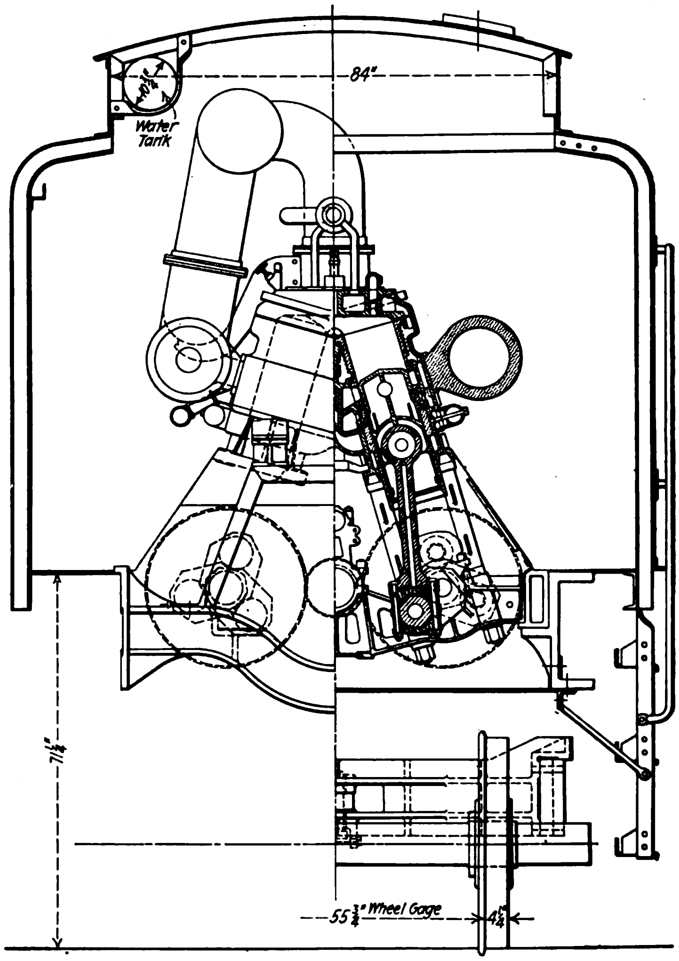
While no attempt has yet been made to test the loco-



Cross section at the generator end of the cab

motive accurately in actual service, the following operating results have been obtained. The locomotive has handled 1,000-ton trains from Reading to Tamaqua, a distance of approximately 40 miles, about three-quarters of which is upgrade at the rate of about .7 per cent with an average of 3.3 gal. of fuel oil per 1,000 gross ton-miles. It has moved these trains over the grade at a speed of approximately 16 miles an hour. On the runs in the reverse direction, with 2,000-ton trains, the fuel consumption averaged one gallon per 1,000 gross ton-miles.

The block tests of the engine indicate a fuel consumption of .40 lb. per horsepower hour at full load, increasing to .45 lb. per horsepower hour at half load. The



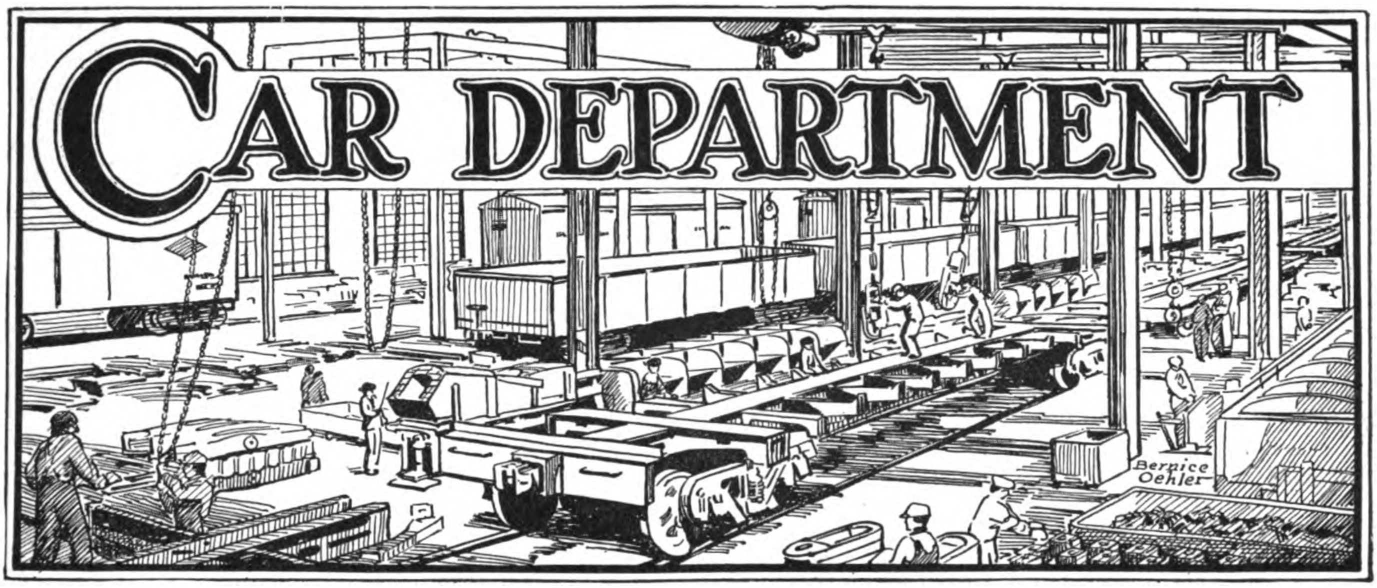
Cross section through the locomotive, showing a section through one of the oil-engine cylinders—the scavenging air manifold is shown at the left and a section through the exhaust manifold is shown at the right

engine has developed a maximum crank shaft speed of 480 r.p.m. It operates smoothly with very little vibration.

Principal dimensions and proportions of the Baldwin Diesel-electric locomotive

Builder	Baldwin Locomotive Works
Type	Diesel-electric
Weights on drivers	180,000 lb.
Total weight	275,000 lb.
Wheel bases:	
Truck	12 ft. 8 in.
Total locomotive	30 ft. 4 in.
Diesel engine:	
Type	Knudsen, 12 cyl., 2 cycle
Rated capacity	1,000 hp.
Cylinders, diameter and stroke	9¾ in. by 13½ in.
Generator:	
Type	Westinghouse, 750 kw. d.c.
Voltage	750
Motors:	
Number	4
Type	Westinghouse, Type 353-D-3, 200 hp.
Capacity of fuel tanks	750 gal.
Length over couplers	52 ft. 1¾ in.
Diameter of wheels	40 in.
Size of journals	7½ in. by 14 in.

The Bureau of Locomotive Inspection of the Interstate Commerce Commission in September inspected 6,556 locomotives, of which 2,835 were found defective and 302 were ordered out of service, according to the Interstate Commerce Commission's monthly report to the President on the condition of railroad equipment. The Bureau of Safety inspected 120,242 freight cars, of which 4,705 were found defective, and 2,175 passenger cars, of which 30 were found defective.



Testing paint by the removed film method

The presence of inferior bases and reducing oils can be easily determined—Tests of new stock prevent waste

ABSTRACTS of a number of papers presented at the fourth annual meeting of the Equipment Painting Section of the Mechanical Division, American Railway Association, held at St. Paul, Minn., the week of September 14, were published in the October issue of the *Railway Mechanical Engineer,* page 635. Following are abstracts of a paper and a committee report on the general subject of paint testing.

Is testing paint stock a useless innovation?

By W. O. Quest
Foreman painter, P. & L. E., McKees Rocks, Pa.

In all trade craft activities, new methods, ideas and materials are rapidly advancing. The paint craft is facing its share of an endless introduction of the by-product discoveries developed by alleged scientific research and doubtful authorities. Seemingly strange, bad and very bad paint stock threaten to keep the craft guessing and in order to feel safe, the future painter will possibly be compelled to study chemistry before claiming to know his business thoroughly.

This threatened future study of the chemistry of paint is also a vivid reminder of the activities of the late C. B. Dudley, chief chemist, Pennsylvania, Altoona, Pa., who decided that all new paint and varnish stock or formula should be tested through the medium of applied and removed films instead of by the separate raw material analysis before combining.

During the years of the writer's experience, oils, paints, varnishes, lacquers, liquid wax reducers, tars, etc., were removed and put on the "judgment drying line," with varied and surprising oxidizing results. Some of the best looking and working combinations when hung up would become brittle and fall off in a few days; others would soften up and, ribbon like, badly stretch down, showing other extremes of the freakish nature and action of the impracticably combined paint stock.

Until time made him wise to the unlimited deviltries of some paint offerings on the market, the writer was much exercised in finding formulas for paint that were soluble in water in the floating off process. In several such experiences, the water solubility action was so great that the removed film was almost reduced back to the liquid state. There were a number of instances where the watersoaked films turned white and failed to dry out normally as any pure paint stock should. As this phase of the trouble usually followed some claimed "world beating new stuff," he decided the cause to be a soapy over-oxidation of some water, sensitive over-emulsionized greases or other like matter, or through the use of some burnt-up precipitated kettle bottoms, called carbon waxes or gums susceptible to water contact. As this trouble was found repeatedly in film tests, it can readily be seen what would be sure to happen, and does happen, when such water permeating paint bases are weather exposed as a protective paint.

There were first class, honestly manufactured gum-bodied reducing oils that retained their elasticity through the removed film tests. There were also similar appearing oils and handling oils found to be absolutely worthless for any protective paint purpose. As an old-timer, the writer was pleased to find that for craft convenience, critical safety, etc., linseed oil would always show its presence; that the best substitutes were always linseed oil based; that in combinations, commercially pure, or in its most perfect refined "lin-oxylin form," it would show

up in the film tests with such gratifying results that he was thankful there was such a reliable, generally accepted material as linseed oil.

There seemingly is no limit to the fixed base substitute and reducing paint oil production. Some of the offerings were so gelatinous that they would liver up, waxlike, beyond the possibilities of further reducing out; others would drop their essential drying matter, slowing up the reducer of the sample. In the tests the substitute lower grade of oils would always throw off more volatile matter.

The principal substitutes filmed were selected as known to be generally used in combination or as straight substitutes for linseed. In order to be fair, the filmed base substituted oils were all used raw and ground in the same grade of pigment and also the proportion of special japan or other reducing matter.

Bodied-up cotton, corn, peanut, rape, parrilla, fixed pine and several mystery oils were pigment based and filmed. The parrilla made the best body showing but was hard to handle, notwithstanding that it is claimed to be linseed's nearest rival, and possibly is, if skillfully handled.

Mineral oils, in the film tests, were a source of many hard efforts and disappointments. For test purposes, the finest samples procurable were used, including beautiful bodied oils which were air-blown, acid-neutralized, deblumed, grease-rectified, etc., especially fixed for protective paint-making. They would seemingly build up fairly well in the coating process but when it came to floating them off, the paint body would sweat away leaving nothing viscous but a glaze of under dried-on admixtures to float off.

Grease oils—We will only include in this paper the commercially known and used heavy-bodied fish oils, which in film making are handled very much like heavy-bodied linseed. When filmed, the better grades of refined fish oil would build up a heavy film with less coats than any of the other oils under test. The method of handling the fish oils was similar to all other oils: by applying with a brush, repeating the coatings. When the desired number of coats were on, the films were racked until ready to float off. These always required more drying time than the best and worst of the lighter bodied oil substitutes. But, as the drying power of the japans used was the principal object of interest in the grease-oil tests, there was little attention paid to the slower oxidation of the fish oil racked films. Many of the films of the better grades of refined fish oils were beautiful in body and appearance. In the impracticable slow-drying tests, the record kept showed that there was but little volatile loss. As the oils had not been excessively heat-combined with other material, the films had but little tac. Taking the oil tests all together, it is predicted that the future best fixed paint oil for protective paints will include the refined fish oil as an oxidizing retarder that will give results not experienced today in protective paint for structural metal. The writer is convinced of this and also predicts that the use of any kind of oil in combination, when studied out, will make the manufactured combined oil the best on a staple priced market. The desired combined oil will be a viscous quick set-up, in order that it may be used safely by heavy brush or mechanical application without the prejudice usually encountered today. There will be no excessive thinning or rubbing out. The applied body of protective paint will be a tough elastic film, oxidizing from the bottom out which cannot be had by a light-bodied paint unless at unnecessary labor cost. It will not be a question as to how much a gallon of paint will cover, but how long it will last.

Varnish films—As a good grade of varnish is usually tough and elastic, there is never any trouble in floating off. A pure linseed, hard or soft fossil gum combination, will turn white when floated off, but will naturally dry on a line in a day or two. In removing varnish films, if large, they must be stripped squarely with the wood along the top, so as to prevent the water-softened film from sagging irregularly while drying on the line. A small film of two or three coats is sufficient for a shop paint or varnish test. For large reference tests, to be handled repeatedly, apply eight or ten coats according to the weight of the varnish filmed. The oxidizing loss in making varnish films was found to be from 50 to 60 per cent. The protective paint loss will average about 33 per cent.

Shellac films—Shellac films were made to detect the purity of the gums. It was discovered that the smelly, so-called mineral distillate denatured alcohol, made a tougher wearing shellac and retarded the drying but slightly. It also helped the working qualities, owing to its slower volatility which was very noticeable in film tests and considerably so when compared with the films made with wood alcohol, denatured alcohol, or the grain proof, spirit quick volatiles. A film made from pure hard gum shellac will not stretch much on the line. An adulterated soft gum will stretch and may ruin the test film. All shellac films, owing to taking up oxygen on both sides on removal, soon become brittle with but little time variation.

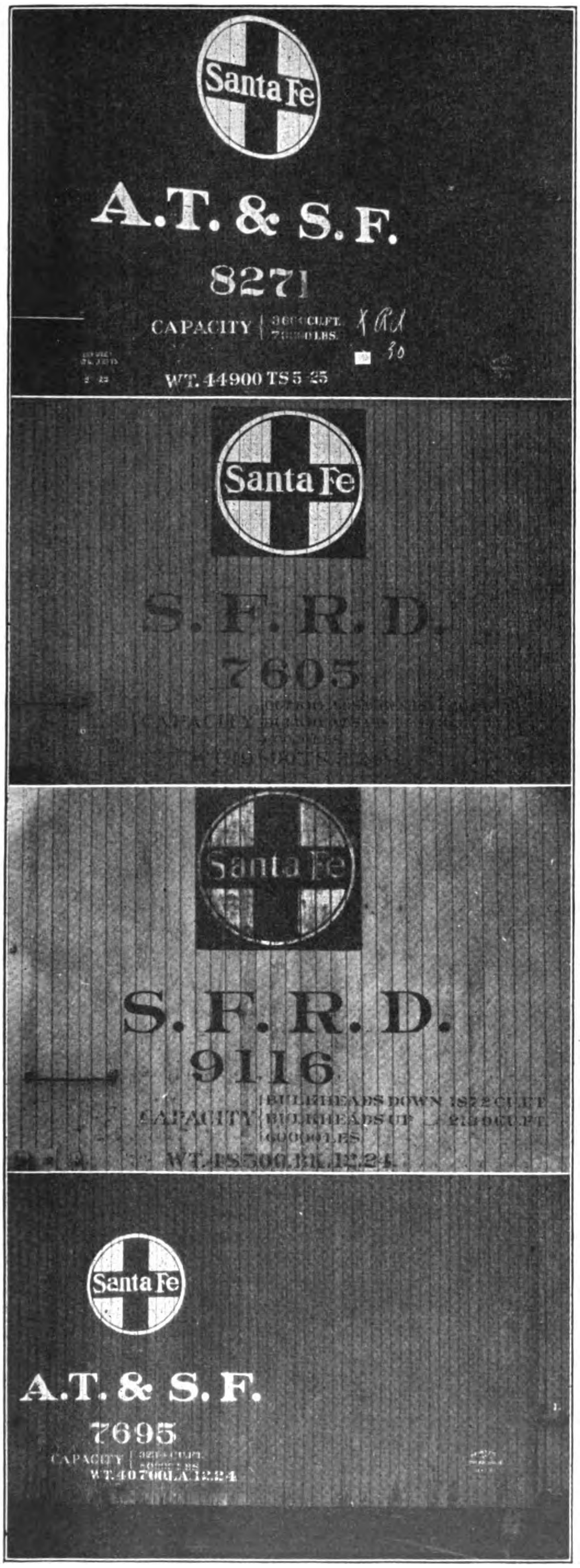
Lacquers—In the old days of the brass-trimmed coach, films were made in the buffing and plating department of what was called dipping and baking lacquers, in order to ascertain the body weight of competitive priced lacquer offerings. The more recent introduction of kindred lacquer specialties, designed for weather exposure in the form of a complete quick surfacing system, and complete finishes, threatens to displace the old-time paint and varnish surfacing systems, as is indicated today by its large and rapidly increasing use in automobile and like surface paintings. It evidently is making good in the demand for quicker surfacing methods.

Damar varnish—The purity and elastic quality of Damar varnish can be film tested like shellac gum. If material other than hard Batavia gum is used, the softer adulterant gums will show granulation in the water floating-off process, through the film's wet surface which to the eye will disappear when dried out. Without essential binding admixtures, such stuff is not fit to use for any purpose, as the best hard-gum Damar varnish made is not any too good in a car paint shop.

Tar films—Natural and manufactured tar films were taken off to ascertain their protective and fire-repelling qualities. Commercial preparations as well as shop-prepared products of good coal tars further reduced in viscosity by a gentle heat evaporation to eliminate the ammonia as much as possible, were the carrying vehicles, with a little fish-oil as a binder and slow-up. Asbestos and magnesia fibre, in dust form, were used freely as the proposed fire-proofing material. A heavy one-coat paste was usually knifed on. As both natural and manufactured tars are heat by-products, the fire-resisting qualities of the removed films were wonderful, especially in locomotive spark and cinder abrasion resistance, but the sterling worth of the tar coatings, owing to the appearance, did not meet with official recognition at that time.

How to make films

The method and equipment for making films is very simple. A shallow water-tight box of a size to float off the largest film wanted, consists of square frames made of wood strips two inches wide and of any desired length. It is covered with tightly stretched cheesecloth and tacked along the edges; then smooth-surfaced stout paper is



Examples of box car lettering submitted to show the comparative weathering qualities of titanox and white lead paint

tacked over the cloth. Several coats of glue sizing, of about five ounces of dextrine, fish, white, or other light colored glue to the gallon of water, is then heated and applied with a brush. There should be no runs or missing in applying the sizing. For making small shop films, plates of glass or tin which have been wiped dry with oil or vaseline, may be used, but there is liable to be trouble in pulling the films off.

Report of the Committee on Tests

This committee suggests that the film test has a value that will warrant its careful study. The paint pigment action on oil can be settled in a few years by aid of the removed film test to the satisfaction of the interested craftsmen that do or do not believe that paint failures can be charged to suspected pigments and that they actually destroy the oil. The problem should be settled beyond all doubt by the consistent outdoor exposure of removed films, owing to the fact that the exposed film is taking in oxygen from both sides which rapidly determines any deteriorating pigment action on oil.

Substitute for shellac

The committee tested several substitutes for shellac and has not as yet found one that compares favorably for all purposes and all classes of work. Shellac is used for so many different purposes—that the procurement of one grade of material which will meet all requirements is an advantage.

Spirit lacquer is a spirit varnish intended to do the work of shellac for first coating, sealing and priming purposes. It is made of fossil gum and high proof alcohol. It may be used for brush, mechanical or dip work. It is recommended that this material be given special study by the committee next year.

Substitutes for white lead

Titanox—In a minority report of the test committee last year, a report was made on titanox, describing its composition and tests were submitted to prove its superior whiteness and covering power. It was evident that there were only a few in the convention that had any experience with this material and the subject was referred to the test committee for further experiments.

Your committee reports that from information obtained from widely separated points, it is generally agreed that titanox is far better in covering power than white lead. It covers about one-third more surface than white lead.

At the Topeka shops of the Atchison, Topeka & Santa Fe, titanox has been standard for over two years for stencilling freight equipment and for the painting of railroad crossing signs, whistling posts, ceilings of baggage and mail cars, interiors of dining cars, kitchen and pantry, as well as other places where a first class durable white paint is desired. The illustration is submitted as evidence of the durability of titanox, as well as of its clear white color as compared to lead. Car, S. F. R. D. No. 7,605, shows a Santa Fe monogram which was mechanically painted with titanox in March, 1924; Car S. F. R. D. No. 9,116, was stencilled with white lead by brush in December, 1924, in Bakersfield, Cal. Box car No. 7,695 shows the monogram initials of the road in mechanically applied titanox, the number and other stencilling was stencilled with lead applied by brush. This car was painted and stencilled in November, 1923, at Topeka, Kan., as you will note by the stencil to the left of the car door. You will also note that the latest light weight was stencilled on in Los Angeles, Cal., December, 1924.

We know that acid fumes will darken white lead. No-

reliable contractor will use it in the interior of kitchens and expect it to retain its color.

The good points of titanox paints were outlined in the preceding paragraphs. The following are what might be termed the weak points. A mixture of the two component parts that compose titanox; namely, titanium oxide and barium sulphate, require reinforcing with zinc and other materials to get the best results. When applied by themselves they dry very slowly and chalk freely. Titanox paint will not sandpaper as easily as lead, but the dust has no poisonous effect on the workmen.

B. E. Miller of this committee, reports that he received some titanox that turned a light pink or brownish cast when used in stencilling freight equipment. In the opinion of your committee, this is not common in titanox, as the illustration clearly proves, and after diligent inquiry we can find only one other instance where free iron was found in the pigment. This is reported by W. O. Quest, who states that in the great amount of this material he has used and tested he only found one small batch that contained iron, and a short time after application it had the same discoloration as that reported by Mr. Miller.

Table showing the kind of material applied to each panel and the time allowed for drying

Panel No.	First coat	Second coat	Third coat	Drying first coat, hours	Drying second coat, hours	Drying third coat, hours
1	Red lead straight	Red lead straight	Red lead straight	48	48	48
2	Red lead extended 25%	Red lead extended 25%	Red lead extended 25%	48	48	48
3	Red lead extended 50%	Red lead extended 50%	Red lead extended 50%	48	48	48
4	Lamp black straight	Lamp black straight	Lamp black straight	48	72	72
5	Lamp black extended 25%	Lamp black extended 25%	Lamp black extended 25%	48	48	48
6	Lamp black extended 50%	Lamp black extended 50%	Lamp black extended 50%	48	48	48
7	Iron oxide straight	Iron oxide straight	Iron oxide straight	48	48	48
8	Iron oxide extended 25%	Iron oxide extended 25%	Iron oxide extended 25%	48	48	48
9	Iron oxide extended 50%	Iron oxide extended 50%	Iron oxide extended 50%	48	48	48
10	Blue lead straight	Blue lead straight	Blue lead straight	48	72	72
11	Blue lead extended 25%	Blue lead extended 25%	Blue lead extended 25%	48	48	48
12	Blue lead extended 50%	Blue lead extended 50%	Blue lead extended 50%	48	48	48
13	Red lead straight	Lamp black straight	Lamp black straight	48	48	48
14	Red lead straight	Lamp black extended 25%	Lamp black extended 25%	48	48	48
15	Red lead straight	Lamp black extended 50%	Lamp black extended 50%	48	48	48
16	Red lead extended 25%	Lamp black straight	Lamp black straight	48	48	48
17	Red lead extended 25%	Lamp black extended 25%	Lamp black extended 25%	48	48	48
18	Red lead extended 25%	Lamp black extended 50%	Lamp black extended 50%	48	48	48
19	Red lead extended 50%	Lamp black straight	Lamp black straight	48	48	48
20	Red lead extended 50%	Lamp black extended 25%	Lamp black extended 25%	48	48	48
21	Red lead extended 50%	Lamp black extended 50%	Lamp black extended 50%	48	48	48
22	Red lead straight	Iron oxide straight	Iron oxide straight	48	48	48
23	Red lead straight	Iron oxide extended 25%	Iron oxide extended 25%	48	48	48
24	Red lead straight	Iron oxide extended 50%	Iron oxide extended 50%	48	48	48
25	Red lead extended 25%	Iron oxide straight	Iron oxide straight	48	48	48
26	Red lead extended 25%	Iron oxide extended 25%	Iron oxide extended 25%	48	48	48
27	Red lead extended 25%	Iron oxide extended 50%	Iron oxide extended 50%	48	48	48
30	Red lead extended 50%	Iron oxide straight	Iron oxide straight	48	48	48
31	Red lead extended 50%	Iron oxide extended 25%	Iron oxide extended 25%	48	48	48
32	Red lead extended 50%	Iron oxide extended 50%	Iron oxide extended 50%	48	48	48
33	Iron oxide straight	Lamp black straight	Lamp black straight	48	72	72
34	Iron oxide straight	Lamp black extended 25%	Lamp black extended 25%	48	48	48
35	Iron oxide straight	Lamp black extended 50%	Lamp black extended 50%	48	48	48
36	Red lead straight	60% Red lead 20% Lamp bl. 20% Extended	50% Lamp bl. 50% Extended	48	48	48
37	Red lead straight	50% Lamp bl. 50% Extended Ground in raw linseed oil to paste reduced with fair grade paint oil proportion, 1 volume paste, 1½ vol. oil.	50% Lamp bl. 50% Extended Ground in raw linseed oil to paste reduced with fair grade paint oil proportion, 1 volume paste, 1½ vol. oil.	48	5	5
38	Three coats: ⅓ Basic lead chromate. ⅓ Lead Sulphate. ⅓ Lead chromate.	Ground in raw linseed oil reduced with boiled linseed oil.	Ground in raw linseed oil reduced with boiled linseed oil.	24	24	24

Panels exposed Nov. 24, 1924.

There has been doubt in the minds of some whether or not this material is as cheap as white lead. When we consider that the difference in cost per pound in paste form is only from 2 to 2½ cents, and that it is generally conceded that a 100 lb. of titanox will make at least one gallon more paint than 100 lb. of white lead and that this mixture will cover a third more surface than the white lead, your committee can see no reason why paints with a titanox base should not be given preference for many purposes over those containing white lead.

Undercoatings for pyroxalin lacquer finish

Your committee, to which was referred the question of pyroxalin lacquer under-coatings, reports that search was made of all available sources for information as to the possibility of getting a lacquer system of primers and surfaces as under coatings, either for pyroxalin lacquer finishes, or the long oil enamel, or a varnish system for finishing railroad equipment. The information received from the original producers of the pyroxalin system was discouraging. But it was recognized that if there was any merit in the lacquer method, the greatest saving of time required to finish a job could be made in extending the method to the under-coats. We made further inquiries and learned that one paint manufacturing firm was specializing on lacquered surfacers. We have tested its method on a number of cars with the following results as to time:

First day—Prime putty and knife-in where needed. If the car has been knifed-in all over, only one coat of surfacer is required which should be applied on the second day.
Second day—If the liquid surfacer is required to fill up a smooth surface, two or more coats should be applied.
Third day—Rub with wet or dry sandpaper.
Fourth day—Apply one coat of enamel body color.
Fifth day—Letter with gold leaf.
Sixth day—Apply first coat of wearing body varnish.
Eighth day—Apply second coat of wearing body varnish.
Tenth day—Car placed in service.

This method saves at least four days' time and gives the same general appearance that first-class railroads have heretofore obtained with the old time surfacer system and varnish methods.

If the pyroxalin lacquer finish was applied over the above surfacer system, it would mean that on the fourth day we would apply three coats of lacquer; on the fifth day we would apply gold leaf letters and figures; sixth day, pencil varnish over letters and figures; eighth day, apply second coat of varnish over letters and figures, the car being placed in service on the tenth day.

You will note that the lacquer finish does not save any time as compared to the varnish finish but is handicapped by the fact that it is practically an impossibility to apply sufficient varnish with a pencil to properly protect the gold leaf letters and figures. If a car is lettered and numbered with enamel colors, the car can be finished on the sixth day and placed in service on the eighth day. The method recommended by most of the firms who advocate pyroxalin lacquer finishes is to bring a car up as follows:

First day—Prime.
Third day—Apply body coat.
Fourth day—Putty and knife-in.
Fifth day—Apply surfacer coat.
Sixth day—Rub with wet or dry sandpaper.
Seventh day—Apply three coats of pyroxalin lacquer.
Eighth day—Letter and number with gold leaf.
Ninth day—Varnish over letters and figures.
Eleventh day—Varnish over letters and figures.
Thirteenth day—Car placed in service.

This saves one day's time over our present methods but does not give equal protection to the gold leaf letters. Therefore, the only object any one can have in using this method is the claim that the lacquer finish is practically indestructible and is more easily cleaned. These two claims are yet to be verified by actual experience. On the other hand, the pyroxalin under-coats not only save time in shopping but a smooth surface is obtained with less labor. The durability of this method, however, is questioned by many who have experimented in its manufacture. There are cars that have been in service for eleven months on which this primer and surfacer have been applied that show no deterioration.

If the claim made in regard to durability and ease with which the lacquer finish can be cleaned is substantiated by experience, your committee would suggest that it might be a satisfactory finish where enamel lettering colors are used.

Your committee having read the warning sent out by the insurance underwriters in regard to the use of these lacquers wishes to state that while we believe their warning is overdrawn and that they are making demands not in accordance with past practices in handling materials that are in our opinion more inflammable than the pyroxalin lacquers, we do endorse their recommendation that a segregated portion of the shop be equipped with an efficient ventilating system for the application of pyroxalin lacquers.

What paints are the most effective and cheapest for the preservation of metal surfaces?

The question of protecting steel cars from corrosion is becoming more important every day. This is due to a realization of the necessity of conserving our natural resources and reducing the expense of corroding steel cars and structures of various kinds that have to be replaced.

The only way of preventing steel from going back to its original state, is to protect the steel by an efficient film of paint to prevent the access of oxygen, sulphur, other gases and water to the surface of the steel. The paint film should, as far as possible, be a non-conductor to prevent any electrical action. After rusting has started it is difficult to stop. This action, while retarded, is not completely checked by painting over the rusted parts.

There have always been many opinions as to the best paints to use for the preservation of metal surfaces and the effect of using inert materials, such as asbestine, calcium carbonate, china clay, etc., which have a tendency to cheapen the paint mixtures. Some say they destroy their efficiency and others say they reinforce and make them more efficient. A number of paints were made up in Roanoke, Va., shops of the Norfolk & Western and applied to a series of 36 steel panels 10 in. by 16 in. by 1/16 in.

It was decided to use for the test the following pigments: basic lead chromate, sometimes called American vermilion; red lead, lamp black, metallic brown or iron oxide and blue lead. It was decided to use an inert extender in different proportions to cheapen the cost of the paint mixtures and to determine what quantities of extender might be used without reducing the efficiency of the paint. The idea was to select an extender that would answer for all mixtures. On account of its general characteristics and structure or form, asbestine was selected as the most suitable material for the purpose.

Boiled linseed oil was used as the vehicle for all mixtures except the red lead mixtures and one panel painted over red lead with a paint made up with a fair grade of paint reducing oil. All mixtures were ground reasonably fine except the red lead. In every case the red lead was mixed according to the Norfolk & Western standard formula; i.e., 20 lb. of dry red lead mixed in two quarts raw linseed oil to a paste, allowed to stand over night, thinned for use with one pint of raw linseed oil and one pint of turpentine. This mixture weighs exactly 26 lb. to the gallon and should be freshly mixed every 48 hrs.

A description or chemical analysis of the material used is shown as follows:

Red lead	True red lead (Pb_3O_4)	91.82
	Lead oxide	8.90
	Undetermined	.18
Boiled oil	Specific Gravity	.934
	Flash	545°F
	Iodine number	180
	Color O. K.	
	Odor O. K.	
	Manganese present.	

Turpentine—Pure.
Lamp black—Good quality, approximately 97 per cent carbon.
Blue lead—Lead sulphate one of the standard brands.
Oxide of iron—Sesqui oxide of iron 48.25 per cent, remainder siliceous material.
Basic lead chromate—Is a composition of approximately 33⅓ per cent each, basic lead chromate, lead sulphate and lead carbonate.

No dryer was used in any case. All proportions of the extender were calculated by volume. All panels were sandblasted and received three coats.

The cost of these paints varied from approximately $0.80 to $3.50 a gallon.

The table shows what paint was applied to each panel and also the drying time allowed. The panels were exposed on the roof of the paint stock house with a southern exposure for about 10 months and, as we expected, they do not as yet show any marked developments. This test is now being extended to include the straight basic lead chromate, basic lead chromate with different proportions of iron oxide, different proportions of silica, also asphalts, oilsonites, ets., over rusted surfaces.

The report was signed by the chairman, James Gratton, general foreman painter, B. R. & P.; John McDowell, foreman painter, C. R. I. & P.; J. W. Gibbons, general master painter, A. T. & S. F.; B. E. Miller, master painter, D. L. & W.; Marceau Thierry, foreman, paint shop, N. & W.; L. B. Jensen, general foreman, passenger department, C. M. & St. P.; Thos. M. Davies, foreman painter, S. P.; F. B. Davenport, foreman painter, Penna.

IN RESPONSE to a letter from W. J. Harahan, chairman of the railroads' train control committee, urging a postponement of the effective date of the second train control order requiring the installation on the second division of the original 45 roads, the Interstate Commerce Commission has declined to entertain a blanket petition; but this does not prevent the filing of petitions by individual roads.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Proper charge for replacing second-hand cast steel wheels with new cast iron wheels

On August 22, 1922, Louisville & Nashville box car No. 16859 was repaired, a change of wheels being made on account of a cut journal. One pair of second-hand Davis cast steel wheels mounted on a second-hand A.R.A. standard axle were removed and replaced with new cast iron wheels mounted on a new A.R.A. standard axle. The charges, amounting to $182.61, representing the difference in value of the axle and wheels removed and those replaced, were assessed against the car owner by the Charleston & Western Carolina, the repairing line. The C. & W. C. contended that the charges and credit for this repair were made in conformity with Supplement No. 1, Items 192, 193 and 197, Rule 101. The repairing line assumed responsibility for the cut journal and restored the car to its original condition and then gave the car owner credit for the scrap axle at second-hand value. It therefore contended that the additional expense due to the application of new wheels and a new axle should be borne by the car owner as the repair constituted a betterment to the car. The L. & N. contended in its statement that the charge for the new wheels and axle applied should not have exceeded that of second-hand material as this repair work was nothing more than an ordinary case of wheels changed on account of a handling line defect.

In rendering its decision the Arbitration Committee sustained the contention of the L. & N. and stated that the principle of interpretation No. 5 to Rule 98 (1921 Code) applies.—*Case No. 1337, Charleston & Western Carolina vs. Louisville & Nashville.*

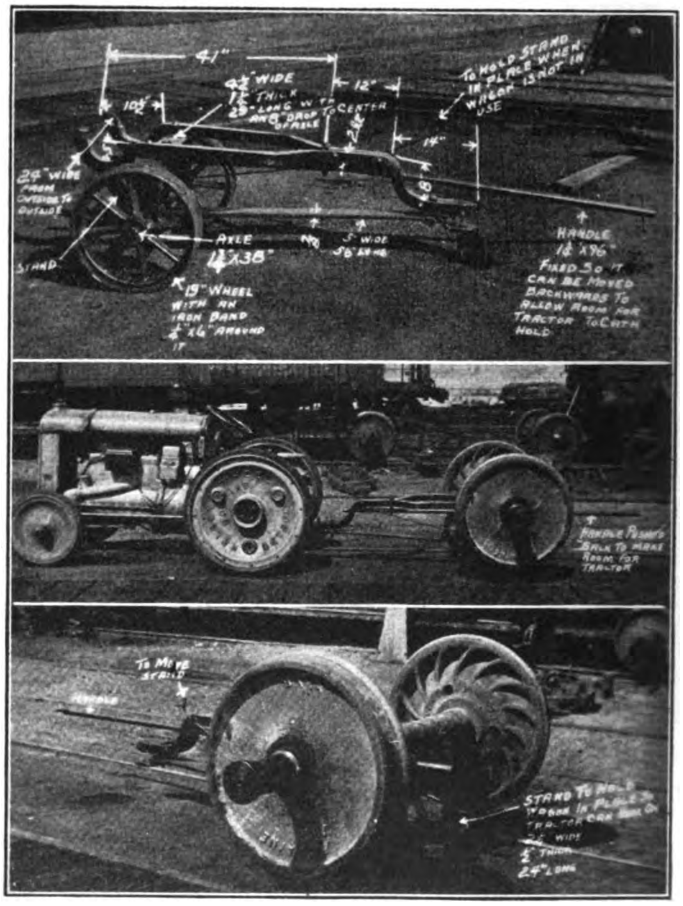
Another case under Rule 32

Chicago & Northwestern stock cars Nos. 17153 and 17347 failed while being handled by the Baltimore & Ohio. Car No. 17153 was broken in two, one end dropping on the rails. Both cars were practically destroyed. The B. & O. reported the cars under Rule 112, claiming that the damage to the cars was the owners' responsibility. The car owner objected to this, stating that when the handling line wrecking foreman arrived at the point of the accident, he found that car No. 17153 was broken in two with one end on the ground and the truck shoved back towards the opposite end of the car. This condition constitutes unfair usage within the intent of Rule 32, and places the responsibility for the damage to both cars with the handling line. The handling line stated that the cars were handled in a train of 38 loads and 55 empties. The train was moving at six miles per hour and approaching a crossing when the engineman discovered a signal against his movement and made a service reduction of 10 lb. which caused the slack to run in and buckle the two cars in question. The cars were not cornered, sideswiped, derailed, or in any other way damaged, which under Rule 32, would make the handling line responsible. The B. & O. further contended that all the damage was sustained before the end of the car dropped on the rail.

In rendering its decision the Arbitration Committee stated that the handling line is responsible. Arbitration decisions 1186 and 1236 apply.—*Case No. 1342, Chicago & Northwestern vs. Baltimore & Ohio.*

Transporting wheels with a Fordson tractor

The delivery of wheels in a car yard can be done more efficiently with proper and adequate equipment than when performed by manual labor. Previous to the installation of the equipment shown in the illustration, wheels were handled at the Curtis Bay, Md., car shops of the Baltimore & Ohio, from the supply track to the car by four men. A short time ago a Fordson tractor was added to the equipment at these shops and in order to speed up the delivery of wheels as well as to perform this work more economically, two car repairmen and an apprentice built the wagon shown in the top view



Tractor wheel trailer built for making deliveries from the supply track to the car

of the illustration. We are indebted to W. W. Calder, district master car builder, Baltimore & Ohio, and to the Baltimore & Ohio magazine for the photographs and description of this wagon.

The wagon consists essentially of two cast iron wheels and a chassis on which provision has been made for carrying the wheels on one end while the other end couples directly to the tractor. The important dimensions and details of construction are shown in the top view of the illustration. The wagon is also provided with a handle so that it can be pulled by two men. This handle can be moved back out of the way when the wagon is coupled to the tractor.

Southern increases its car repair facilities

New shop at Hayne, S. C., has monthly output of about 80 passenger and 500 freight cars

By A. B. Brown
Westinghouse Electric & Manufacturing Company

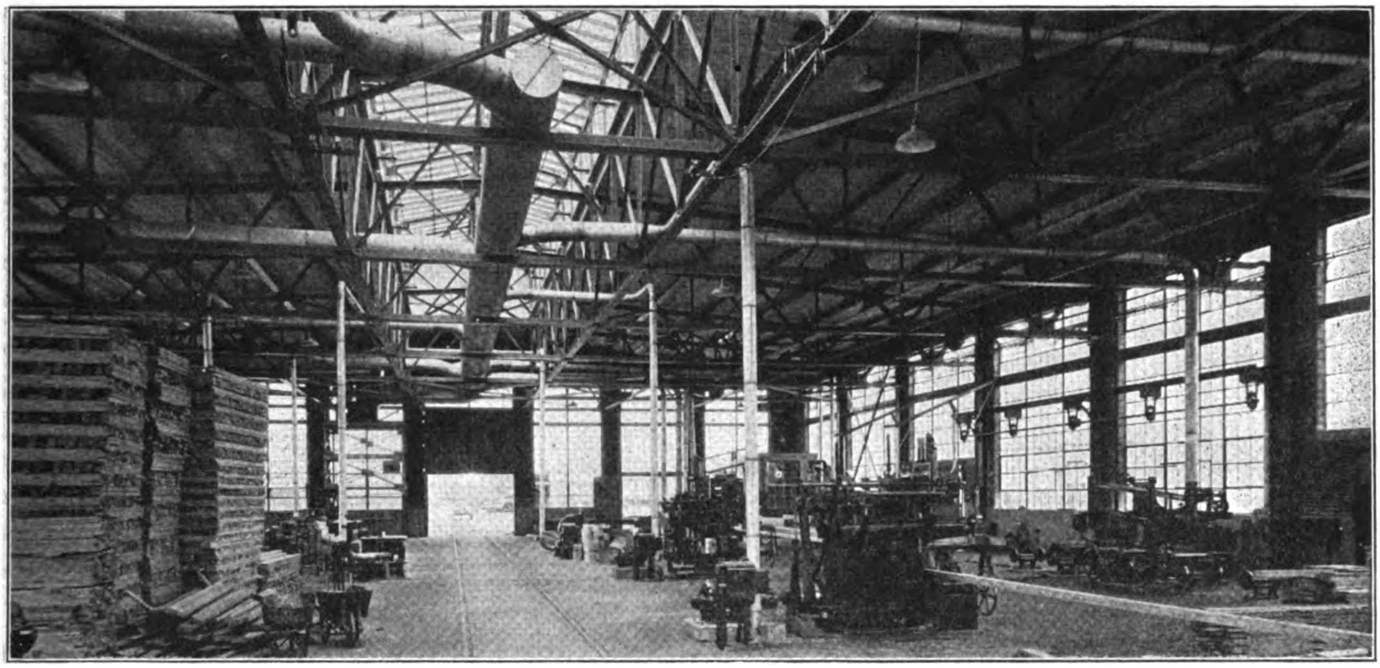
THE Southern Railway, in carrying forward an extensive improvement program, has increased its car repair facilities by the addition of a new shop at Hayne, located near Spartanburg, S. C. This shop was placed in operation, January 2, 1925, and is equipped to handle repairs for both passenger and freight cars. Since that time, it has taken over the work which was formerly handled at Columbia, S. C., and now has facilities for performing general repairs to about 80 passenger cars and to rebuild 500 freight different type cars per month.

Referring to the layout drawing of the car repair tracks and buildings, it will be noted that the shop is laid out to handle repairs by the straight line system. Cars to be repaired are switched into the repair yard, past the reclamation shop building and scrap dock, and are classified both as to class of repairs and type of car. This system simplifies the actual production work to a great extent when the cars are started through the shop.

The freight car department

The freight car shop, 391 ft. long by 107 ft. wide, is of structural and corrugated steel open construction, affording a maximum amount of light and ventilation. It contains five tracks and has capacity for 40 cars. Heavy steel cars are repaired on track No. 1 which is located adjacent to the fabrication shop bay and is served by a 15-ton electric crane. Tracks No. 2 and No. 3 are also served by an electric crane and are used for stripping heavy and medium repair cars, respectively. The straight-line system is also used for light repair work which is done on track No. 4 while track No. 5 is used for finishing up. Permanent scaffolding is provided for the last two tracks.

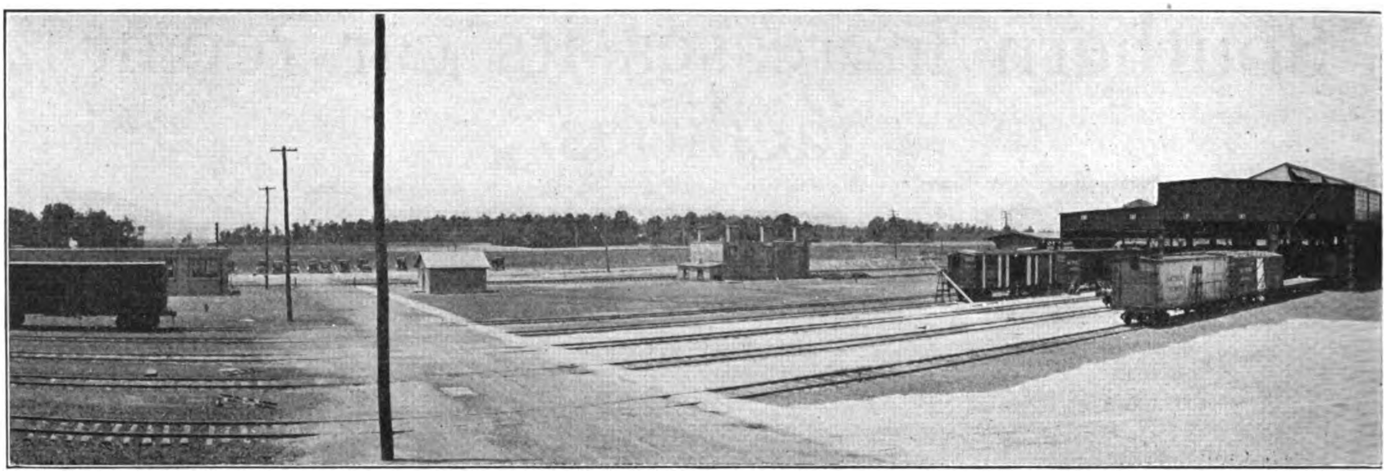
The yards and tracks are so constructed that the cars move on one continuous track practically by gravity from the storage yard through the freight car building to the paint yards. When the cars are placed in the storage yard they are checked up and listed showing the amount of work necessary in order that the material can be gotten out through the different departments, blacksmith and planing mill, in advance of the time the cars are placed for the car repairs. From six to eight days is the average time required for repairing a car; which usually includes one day on the stripping track; three to four days repairing, and two to three days on the paint tracks.



Interior view of the planing mill showing the arrangement of machinery on one side of the mill and the sawdust conveyor system

The planing mill is well equipped

The planing mill is located in a separate building, 100 ft. wide by 162 ft. long and is situated convenient to the freight car repair shop, lumber storage yard and dry kiln, thus effecting minimum hauls to the various points. The building is airy, light and modern in every detail of de-

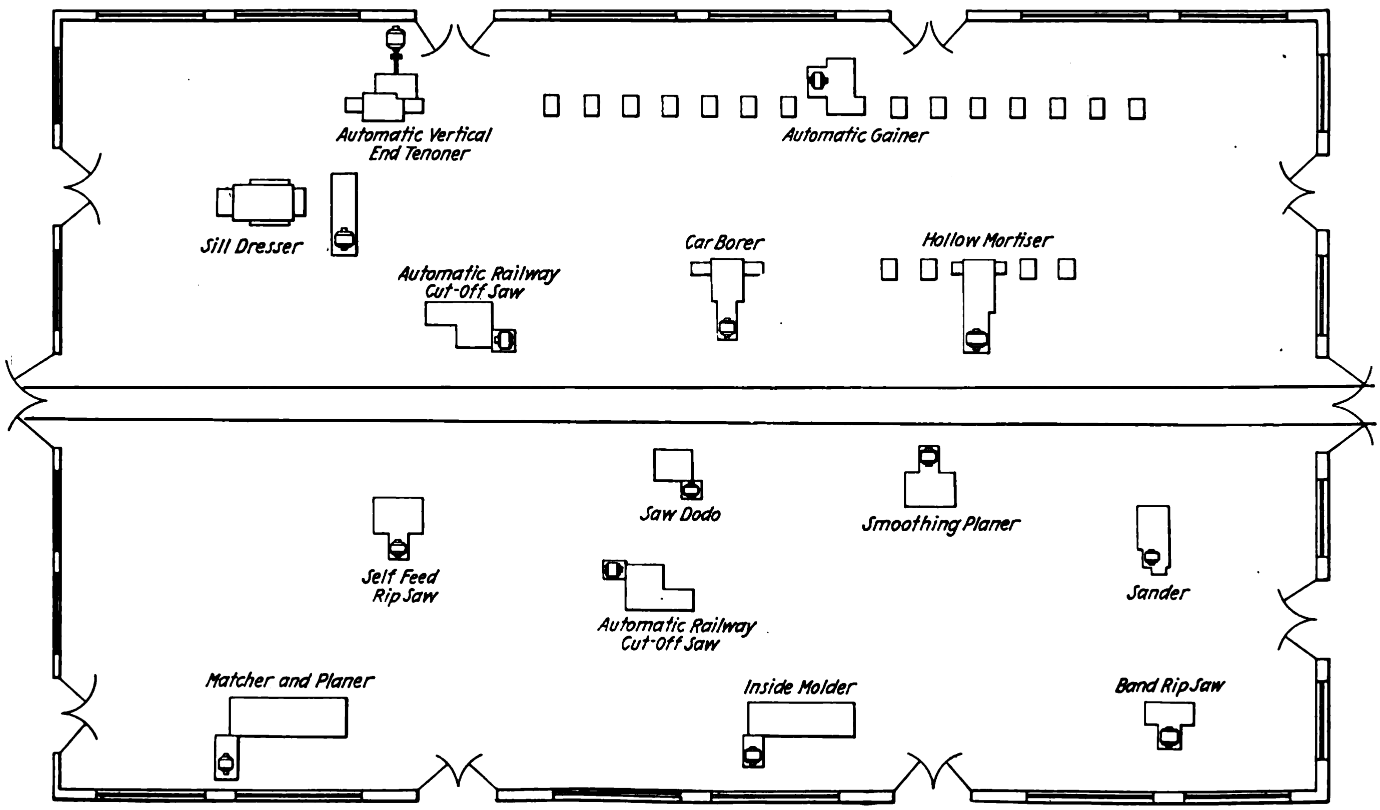


Panoramic view of the Southern Railway's car shops, Hayne, S. C.,

sign. The layout of the machinery is so arranged that the material is carried straight through the different process of cuts without any back-tracking. A suction blower system with pipes to each machine is installed for the removal of sawdust. The sawdust is conveyed to a collector on the outside of the building from which it is removed to cars for shipment.

As can be seen from the layout drawing of the car repair tracks and buildings, there is one supply track running into the planing mill from the lumber yard. The shops are served from here by trucks and tractors as shown in one of the illustrations. After the lumber is machined, it is either taken direct to the car or stored for use when needed. All freight car doors are made in the planing mill and completed with hangers and trimmings ready to be applied to the cars. A steel-top table is located in one corner of the mill where the side doors are assembled. Individual motor drive with automatic push-button control is used on all machine tools. The following equipment is installed in the planing mill:

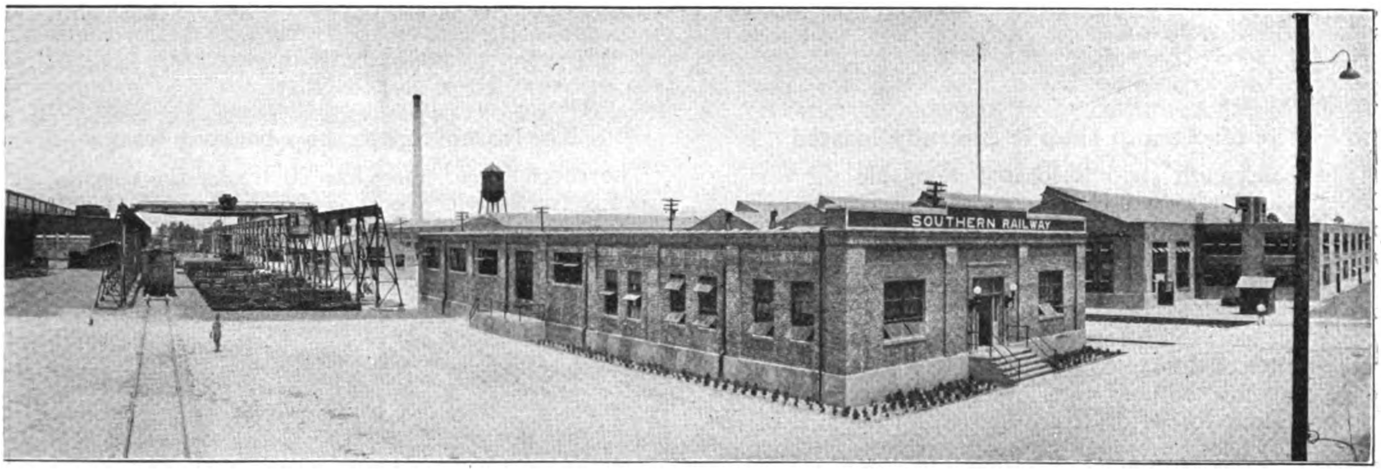
Machine	Manufacturer	Motor drive
90-lb. exhauster	Sturtevant	60-hp. Westinghouse
14-in. matcher	Fay & Egan	50-hp. Westinghouse
36-in. circular saw	Fay & Egan	15-hp. Westinghouse
14-in. by 18-in. planer	Fay & Egan	50-hp. Westinghouse
Tool grinder	Fay & Egan	2-hp. General Electric
Tenoner	Fay & Egan	15-hp. Westinghouse
Gainer	Fay & Egan	20-hp. Westinghouse
Boring machine	Fay & Egan	15-hp. Westinghouse
Mortiser	Fay & Egan	20-hp. Westinghouse
13-in. circular saw	Fay & Egan	5-hp. Westinghouse
36-in. cut-off saw	Fay & Egan	20-hp. Westinghouse
36-in. cut-off saw	Fay & Egan	20-hp. Westinghouse
Machine moulder	Newman	40-hp. Westinghouse
Band saw	Fay & Egan	10-hp. Westinghouse
Sander	Fay & Egan	15-hp. Westinghouse
Tenon machine	Greenlee	15-hp. Westinghouse



Drawing showing the arrangement of machine tools in the planing mill

Kiln for drying lumber

One of the features of the equipment at the Hayne shop is the dry kiln, manufactured by the National Dry Kiln Company, Indianapolis, Ind., for drying lumber used



showing the freight car shop in the center

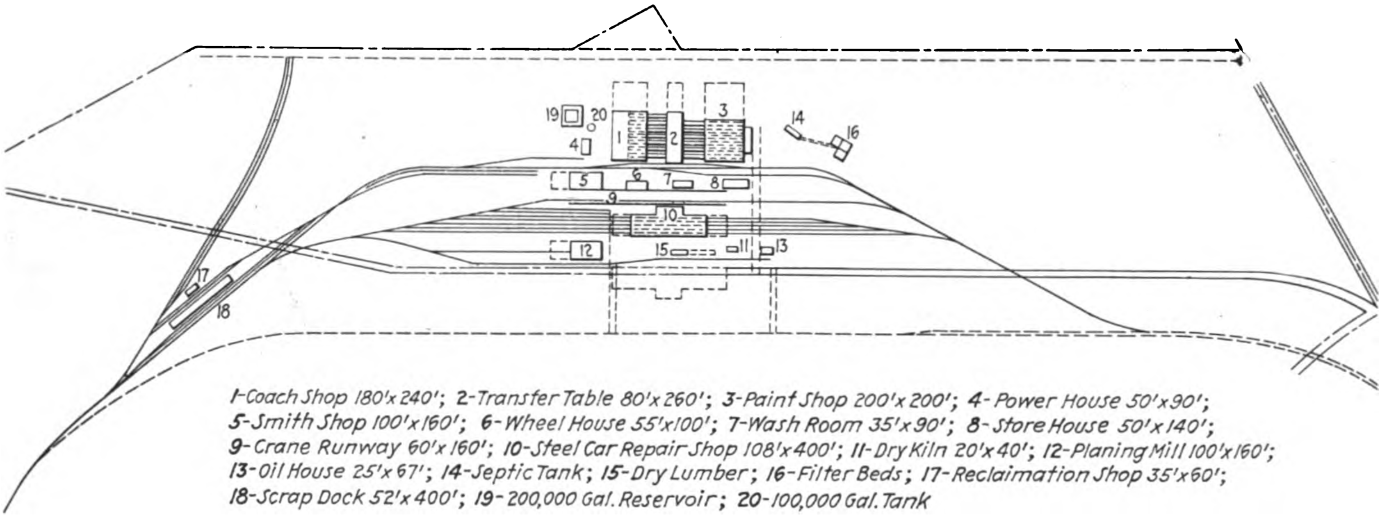
in the repair of passenger coaches and refrigerator cars. The dry kiln is a concrete and brick structure, 40 ft. long by 20 ft. wide with two sliding doors at the front. The kiln contains two tracks where small cars loaded with lumber are placed during the drying period. The drying is accomplished by heat from a double layer of steam pipes under each track. A 3-in. water spray pipe with small holes drilled in each side is located just above the steam pipe.

The lumber is systematically loaded on the cars to allow a maximum amount of air circulation. Careful tests are made and records are kept both before and during the drying period from sample pieces which are chosen from different sections of the pile. A piece is cut off one foot from the end and then the sample piece is cut off for testing on a special scalometer or Evapercenter. From four to six samples of board are tested, tests being made at intervals of from 24 to 48 hrs. The fresh ends of the sample boards are then painted with graphite paint mixed with rosin to prevent drying out at the end. When the final tests have indicated that the moisture content of the stock is down to the desired point, the Moistat is shut off, the heat cut off, and the ventilation closed. The stock is then left from 12 to 24 hrs. with the Moistat and ventilation shut off.

The Moistat is a self-contained thermostatic device for regulating the temperature of the kiln. Its power is obtained from expansive volatile liquids which are sealed in the instrument. These liquids expand and generate pressure in exact proportion to the temperature surrounding the thermostat.

The lumber is allowed to dry itself as long as it gives up its moisture readily. After a time steam is required. The instrument is sensitive to this need through the thermostat, allowing steam to pour into the kiln. This continues until the wet bulb temperature is raised sufficiently to generate a pressure which will be ample to tightly close the valves.

The operating room where tests and records are made adjoins the dry kiln in the rear. Here, is also placed the Moistat regulating device for regulating the temperature of the kiln.



Layout of the car repair tracks and buildings

The fabrication shop

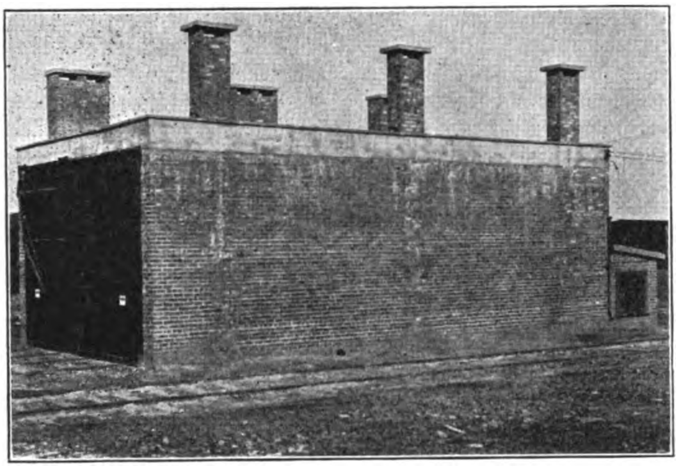
The fabrication shop for working and assemblying metal material used in the repair of steel cars and heavy repairs of wooden cars is built as an annex to the freight car shop proper. The shop is 51 ft. wide by 115 ft. long with one side opening into the freight car shop adjacent to tracks No. 1 and No. 2 where the heavy repairs are made. Both the blacksmith shop and casting docks are situated near the fabrication shop so that the production on metal work may not be delayed by long haulage. The fabrication shop contains the following equipment:

Machine	Manufacturer	Motor Drive
Shear	Cleveland	10-hp. Westinghouse
Drill press	Manning, Maxwell & Moore	3-hp. Westinghouse
Radial drill	Reed Prentice	5-hp. Westinghouse
Punch	Cleveland	10-hp. Westinghouse
Straightening press		

The blacksmith shop is centrally located

The blacksmith shop is located alongside the casting docks where material can be conveniently reached and stored. The building, which is 100 ft. long by 60 ft. wide, is a fire-proof structure of modern design, well lighted and ventilated. It is completely equipped with modern equipment.

Sixteen blacksmith forges are arranged in double rows in the center of the building with ample room around each forge to work without interference. Pressure blowers for providing forced draft are located on the side of the building. There are four high temperature oil burning furnaces placed at convenient points throughout the shop. Oil is pumped from an underground tank to the furnaces by a steam driven oil pump. Exhausts through the roof are provided for the 1500-lb. and 3400-lb. steam hammers. The blacksmith shop was planned with ample capacity to



Kiln for drying lumber to be used in the repair of passenger and refrigerator cars

take care of any future additions that might be made to the car repair shop. The equipment consists in part of:

Machine	Manufacturer	Motor Drive
Turbo considal	Buffalo	7½-hp. Westinghouse
Type R pressure blower	Buffalo	20-hp. Westinghouse
Hammer	Bradley	10-hp. General Electric
Bulldozer	Williams & White	20-hp. Lincoln
Bolt header	Williams & White	16-hp. General Electric
Punch and shear	New Doty	15-hp. Triumph
200 ampere arc welding set	Westinghouse	

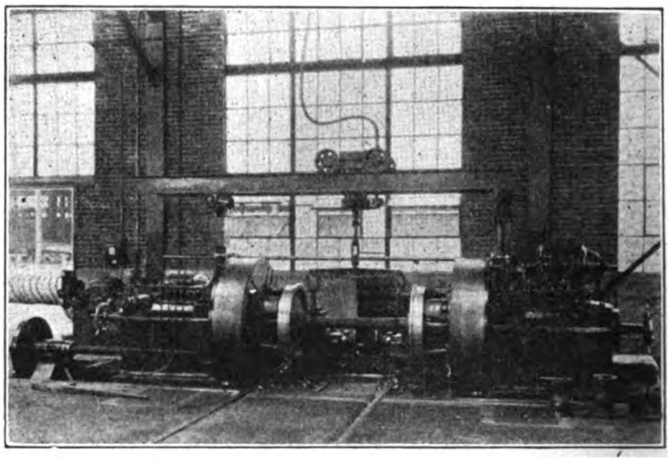
Wheel shop serves for both freight and passenger car repairs

The wheel shop which serves both the freight car and coach repair shop is situated between the two and is readily accessible to both of these departments. There is sufficient storage space for mounted and unmounted wheels and axles. An electric traveling crane serves the storage platform. Like the blacksmith shop, the wheel house was designed to take care of future production far exceeding the present output. The building is 102 ft. long by 55 ft. wide and is of the same general construction as the blacksmith shop and planing mill. Space has been provided for the future installation of an additional axle lathe and boring mill. The equipment includes the following:

Machine	Manufacturer	Motor Drive
Car wheel lathe	Niles-Bement-Pond	50-hp. Westinghouse
Car wheel lathe	Niles-Bement-Pond	10-hp. Westinghouse
400-ton wheel press	Chambersburg	10-hp. Westinghouse
Car wheel borer	Putnam	15-hp. Westinghouse
Axle lathe	Niles-Bement-Pond	15-hp. Westinghouse
18-in. lathe		Westinghouse
26-in. drill press		Westinghouse
32-in. shaper		Westinghouse

The coach repair shop has ten tracks

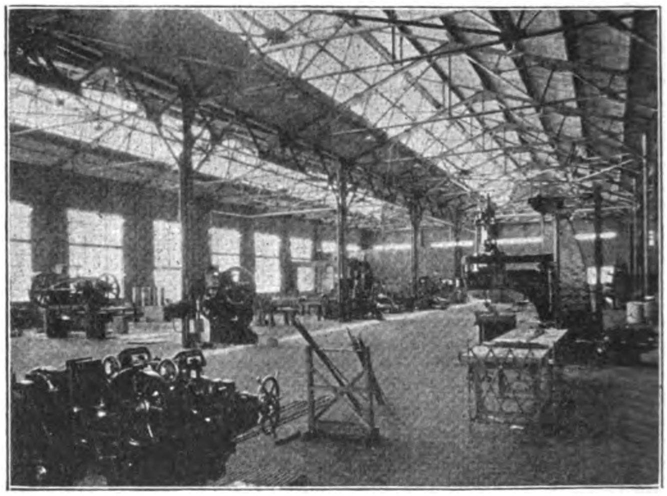
The coach repair shop has 10 tracks for coaches and two for trucks which occupy about one-half of a building, 180 ft. wide by 24 ft. long. The roof is of the saw-tooth design, with skylights on one side of each tooth



Niles-Bement-Pond car wheel lathe installed in the wheel shop

which affords good light and ventilation. Permanent scaffolding is suspended from each column between the tracks. The cross arms of the scaffolds are counterbalanced by weights, enclosed in a casing which protects them from outside interference. Seventeen holes are drilled in the uprights affording adjustments for any desired height of scaffolding.

All passenger cars are brought into the yard and



Coach machine shop—The pipe, tin and cabinet shops are located in the rear

placed on the stripping tracks. At the present time the stripping is done in one side of the paint shop because of the nearness of this location to the different departments for cleaning and painting the coach accessories. The upholster work is taken to the upholster shop and the trimmings to the wash rack. The trimmings are afterwards moved to the paint shop and prepared for re-application to the car.

After the car is stripped it is moved to the outside of the building on a length of track between the transfer

table and paint shop, where the trucks are removed from one end and emergency trucks are substituted. The car is then taken over the transfer table to the opposite side of the tracks where the remaining trucks are removed and emergency trucks are installed. The trucks are then taken to the truck shop for overhauling, and the car to the coach shop for necessary repairs. When the work has been completed on the coaches they are placed back in the paint shop for painting and re-applying the upholstering and trimmings.

The coach machine shop and cabinet shop are located in the same building

The coach machine shop, cabinet shop, tin and pipe shops are located in the coach repair building. This location is advantageous because of its accessibility to the repair tracks. Modern metal and woodworking machinery are used throughout, all of which are equipped with individual electric drive and push-button control. The following is a list of tools in the cabinet shop:

Machine	Manufacturer	Motor drive
Shaper	Fay & Egan	5-hp. Westinghouse
Cabinet planer	Fay & Egan	15-hp. Westinghouse
Band saw	Fay & Egan	5-hp. Westinghouse
Universal worker	Fay & Egan	5-hp. Westinghouse
Universal cabinet saw	Fay & Egan	5-hp. Louis Allis
Molder	Fay & Egan	10-hp. Westinghouse
Mortiser	Wysong & Miller	1½-hp. General Electric
Drill press	Manning, Maxwell & Moore	2-hp. Westinghouse

The machine shop contains the following machine tools:

Machine	Manufacturer	Motor drive
Drill press	Manning, Maxwell & Moore	2-hp. Westinghouse
Shear	Williams & White	10-hp. Westinghouse
Radial drill	Niles-Bement-Pond	10-hp. Westinghouse
Bolt cutter	Acme	5-hp. Westinghouse
Radial drill	Reed Prentice	5-hp. Westinghouse
Angle bender	Ryerson	15-hp. General Electric
Punch and shear	Buffalo	....

The paint shop

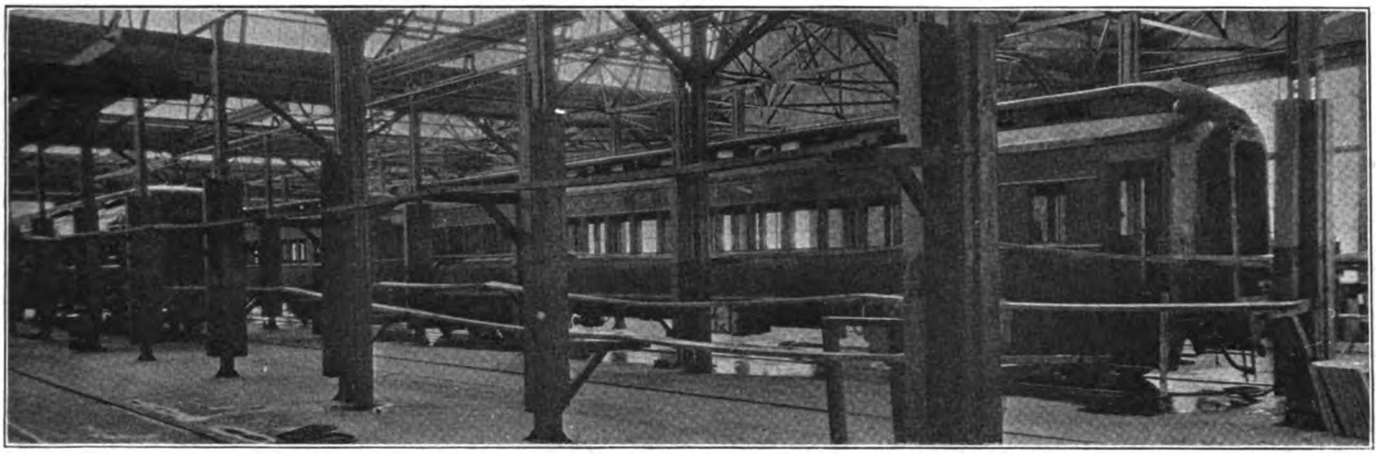
The repaired cars are taken first to an outside track where they are thoroughly cleaned by air and are then taken into the paint shop to be scrubbed. The paint shop has capacity for 20 cars, two cars to a track. Permanent scaffolding, similar to that in coach shop, is provided. The building is heated by steam in cold weather, a constant temperature of 70 deg. being maintained.

In cases where the surface of the wooden coaches is practically gone, the paint is burned off with a kerosene torch. At the present time, paint is removed from steel cars with a paint remover, but it is planned to use sand blast for this work as soon as the apparatus is installed.

Where the surface is in fairly good condition, a primer is put on and allowed to dry for 48 hours. Then coats of No. 2 and No. 3 paint and a surfacing composition are used, in the order named, with intervals of one day between each application. The car is next rubbed to a surface and two coats of body color and two coats of varnish are applied.

If the surface is in good condition, the raw spots are sanded and touched up with a primer. They are then puttied and sanded, after which color and varnish are applied. The trucks and underframes are sprayed after the painting on the coaches has been completed.

A feature of the coach shop layout is the electrically driven transfer table. The table, which is 80 ft. long, is of sufficient length to accommodate the largest coaches. Cars are pulled on and off the table by means of a cable from a drum geared to the main motor. A clutch is provided for disengaging the motor pinion from the main driving gears which transfers the motion to the cable drum. Reversing is obtained with drum control.



Interior view of the paint shop showing the type of scaffolding used in coach repair work

The air brake room

A partitioned space, 22 ft. by 52 ft., in one corner of the coach machine shop is set aside for the air brake room. The equipment includes a universal control rack, triple valve test rack with an auxiliary device and three benches, each 38 in. by 10 ft. A double rack for storing triple valves is placed just outside of the air brake room in the machine shop.

Repaired valves are placed in one section of the rack, while another section is reserved for valves to be repaired. A similar rack is located in the fabrication department of the freight car repair shop in order that the freight cars may be serviced with the least possible delay. This rack is replenished daily.

Department for electro-plating

An electro-plating room is situated in the paint shop building. All brass work such as locks, door hinges, baskets, sash locks and light fixtures are cleaned here. The fixtures are cleaned by boiling in a caustic soda solution. They are then run through an acid solution for brightening. All permanent brass fixtures are next buffed and lacquered, while those requiring an oxidized finish are oxidized with liver of sulpher, run over with a scratch wheel and lacquered.

Here all mirrors and dining car silver are reclaimed and plated. After the silver has been cleaned with Kostico and pumice, it is put in a silver "strike" tank, where a thin coat is applied. It is then dipped into the regular silver tank, taken out and scratched, put back in the silver tank, and finally polished on a wheel. The

same general process is followed for nickel, copper and tin plating with the exception that no "strike" tank is used. The equipment includes a Hanson and Van Winkle, six volt, 100 ampere electro-plating motor generator set and three buffing wheels.

The upholstering department

The upholstering department, where curtains, seats and backs are cleaned and repaired, is located on the second floor, above the plating rooms. The seats are cleaned by a vacuum process. They are then dipped in a cleaner solution and brushed on a high speed rotary brushing machine. Most of the moisture is eliminated by this process and they are drying within two hours.

A novel machine for brushing washed seats is used in this department. It is 4½ ft. long by 1 ft. 9 in. wide and 2 ft. high, having a framework of channel iron. A stiff bristle brush, 9 in. by 14 in. is coupled to a five-hp. motor which revolves at a speed of 1,160 r.p.m. Three two-inch wooden rollers are placed in the front and rear of the brush so the seats may be easily moved back and forth across the revolving brush. The average time for

Fordson tractors are used to handle material

washing the seats and backs of a day coach is 2½ hrs., which is 50 per cent less than the time required by ordinary processes.

Power is secured from the South Carolina Light and Power Company. Two circuits, each 33,000 volts, 3-phase, 60 cycles are available at the sub-station. In the event service is interrupted on one circuit, a change-over can be made to the other circuit, thus assuring continuous power service. The voltage is stepped down through three 500 KVA transformers to 440 volts which is used throughout the shop.

Two 500-hp. O'Brien boilers furnish steam for the dry kiln, steam hammers, heating system and steam-driven air compressor. The equipment also includes a 1,500-cu. ft. motor-driven air compressor. Ample fire protection is assured by a fire pump which delivers 1,000 gal. per min. The plant is provided with a 100,000-gal. tank and a 200,000-gal. reservoir.

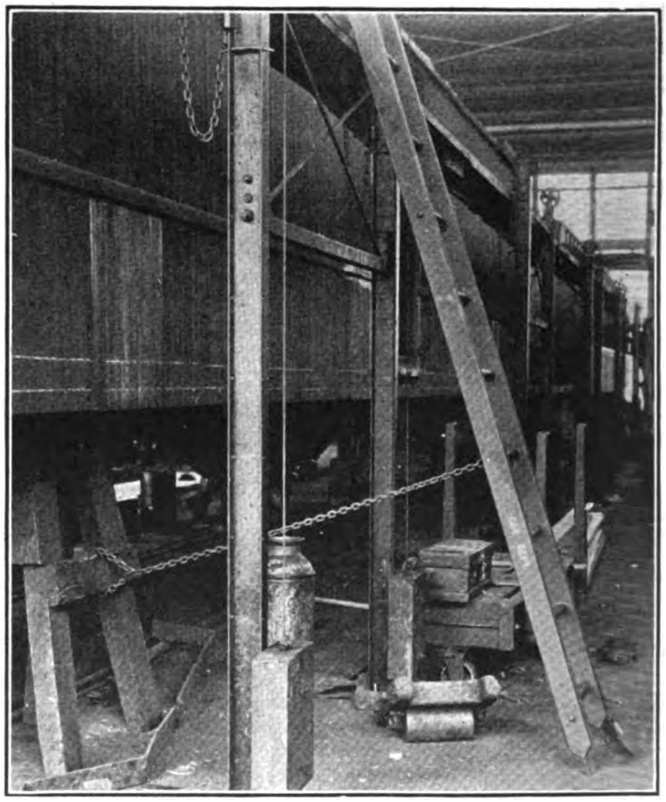
Daily reports are sent to the superintendent's office by each department. In this way a close check is kept on the ratio of production throughout the shop and work can be assigned accordingly.

A foreman's meeting is held once a week. Suggestions regarding new equipment, welfare of the employees and any points which might be of material interest are discussed here. No doubt these meetings have played a prominent part in establishing and maintaining the close co-operation which is evident between the several departments. Much of the credit for the efficient operation of the shop can be attributed to J. O. Johnson, superintendent car shops, who directs its operation.

The Hayne car shop was designed and built under the supervision of H. W. Miller, vice-president, Southern Railway, and R. L. Ettenger, consulting mechanical engineer and assistant to Mr. Miller. Dwight P. Robinson Company were the contractors and constructing engineers.

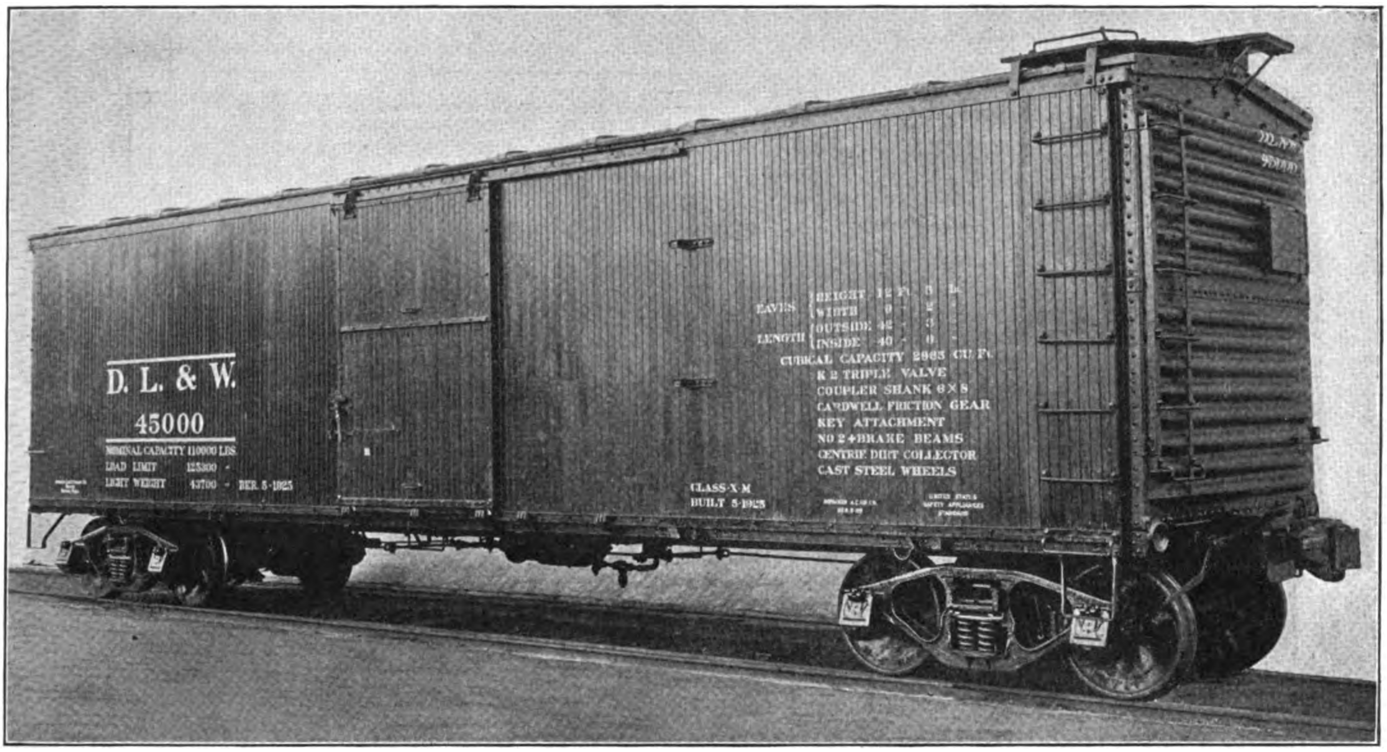
Method of preventing ladders from over-balancing

IT is common practice to provide means to prevent a ladder from slipping on a greasy or otherwise slippery floor. The rail ends of the ladder shown in the illustration are provided with pointed iron grips which is one way of preventing slipping. There is, however, another danger to guard against when using a ladder. In car repair work a ladder is often placed against a scaffolding, as shown in the illustration, so that a portion of



Chain used to prevent a ladder from overbalancing when a workman is on the upper end

it overhangs. The workmen will use the ladder in this position to reach the roof of the car. If the ladder is not properly fastened, his weight on the upper end will cause it to overbalance and result in an accident. A simple but effective way to prevent such accidents is to fasten to the lower end of the ladder a chain, the other end of which is attached to a trestle under the car, as shown in the illustration, or it can be readily fastened to any part of the under construction of the car. The chain is permanently fastened to the ladder, thus preventing it from becoming lost and also eliminating the tendency of a workman of not securing the ladder owing to the fact that there is no chain handy for this purpose.



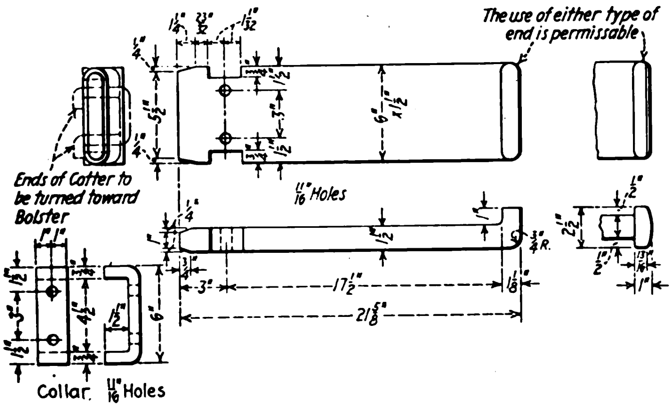
D. L. & W. 55-ton, 40-ft. 6-in., double sheathed box car built according to A. R. A. specifications.

Double sheathed 55-ton box cars for the D. L. & W.

Built according to A.R.A. specifications—Have a carrying capacity of 125,000 lb. and weigh 43,700 lb.

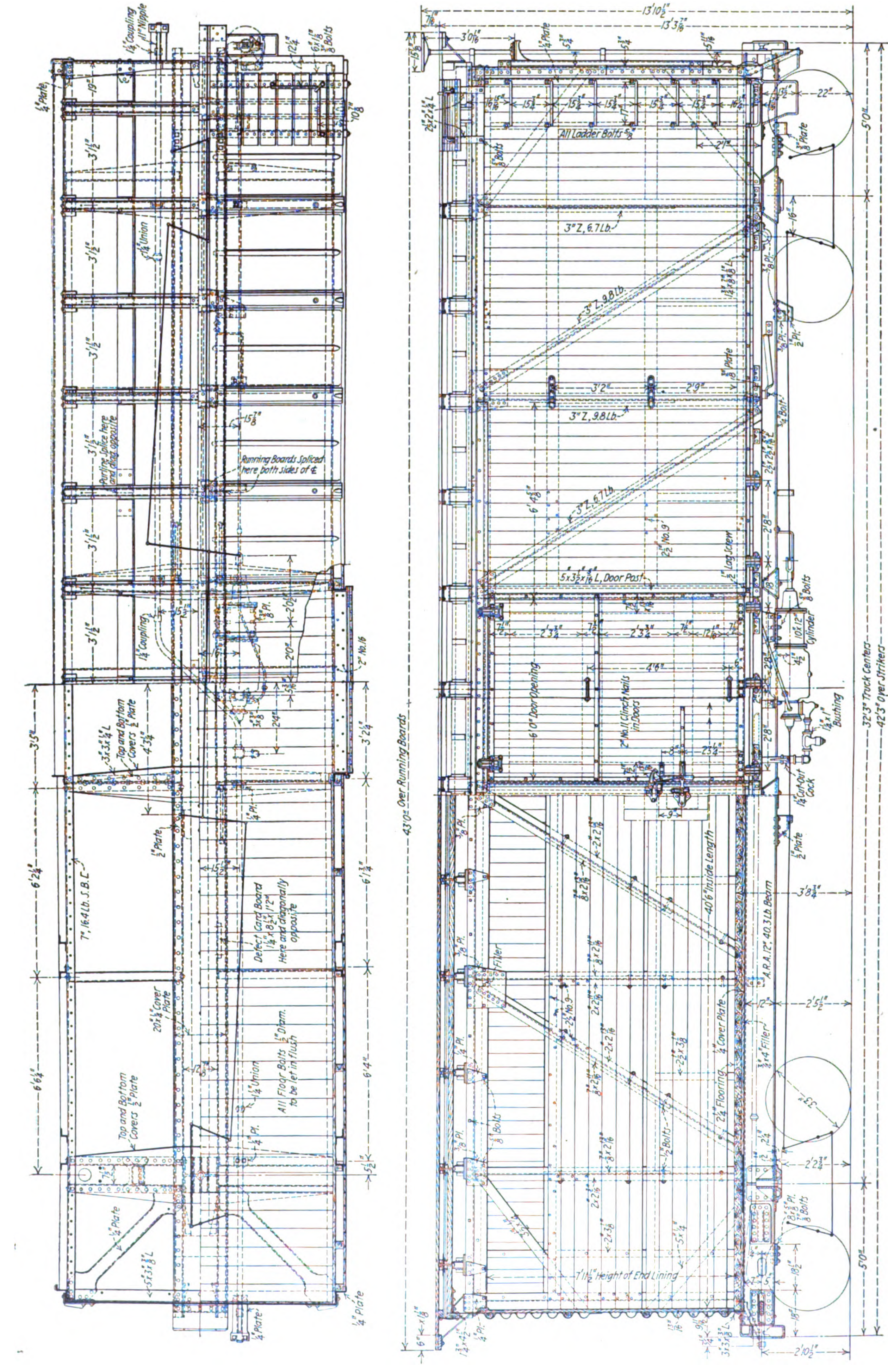
By P. Alquist
Master car builder, D. L. & W., Scranton, Pa.

THE terminal facilities of the railroads serving New York are steadily becoming inadequate to unload quickly the enormous number of cars which enter the metropolitan area every 24 hours. Enlargement of the terminals is restricted by the lack of sufficient ground for expansion. The Delaware, Lackawanna & Western is one of the railroads confronted with this problem at its eastern terminus.



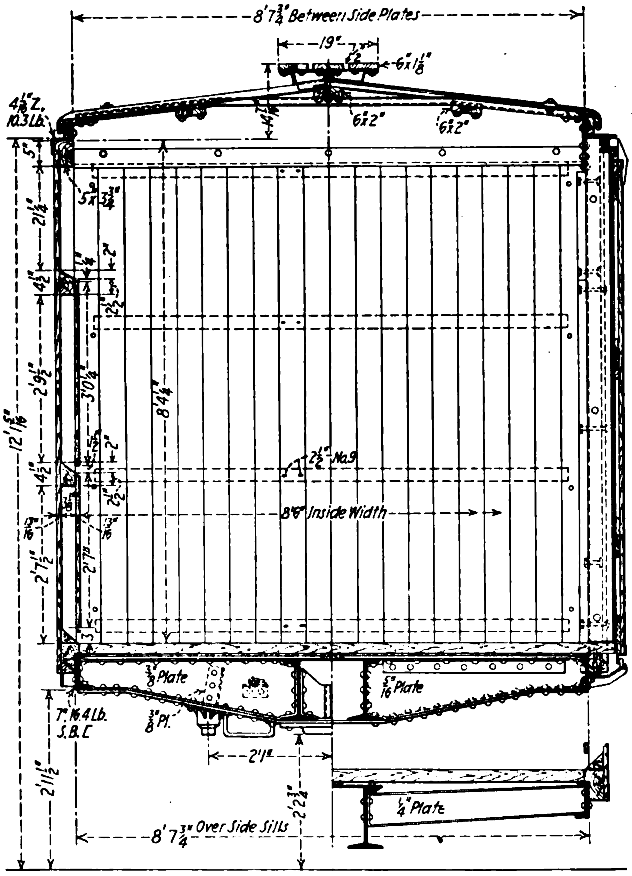
A method of fastening coupler yoke cross key cotters to prevent them from shearing off

One of the methods of combating this problem is to increase the capacity of the cars handling grain, flour, cement, coffee, sugar, etc., without greatly increasing the weight. This was accomplished in the 1,000, 55-ton, steel underframe, double sheathed box cars built by the American Car & Foundry Company, Berwick, Pa., according to A. R. A. specifications. The cars have been in service six months and have proved very satisfactory. These cars were obtained to replace 60,000-lb. capacity equipment retired on account of age, construction and light capacity. The cars dismantled weighed 38,000 lb. The new cars, which will carry 125,000 lb. of grain from the Great Lakes to tidewater, have double the capacity of the old cars, with an increase in weight of only 5,700 lb., or, by increasing the weight of a unit 15 per cent, the carrying capacity was increased 100 per cent. This advantage is particularly noticeable in the room occupied by the trains in the terminal. The capacity of each car unloaded on the grain dock is now equal to two of the older type and it can be unloaded in one-half the time formerly required to unload the same capacity. These cars weigh 1,800 lb. less than the U. S. R. A. 80,000-lb.



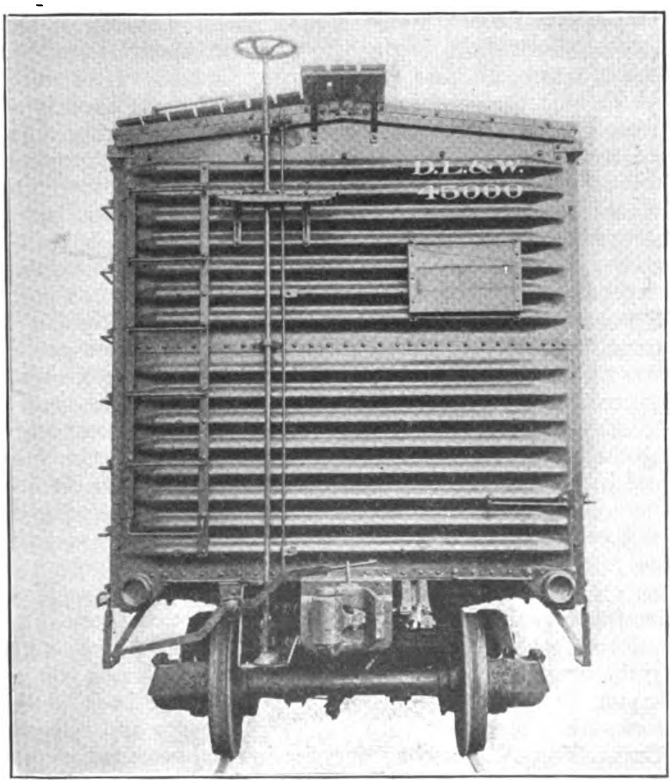
Plan and elevation view of the D. L. & W. double-sheathed 55-ton box car

capacity cars. The switching of our grain trains has been reduced one-half on account of the increased capacity per car. The royalty on patent grain doors and all labor in-



Cross section of D. L. & W. steel frame box car

cident to preparing cars at the loading and unloading points has reduced one-half. Only one-half the number



Murphy corrugated ends are used on these cars

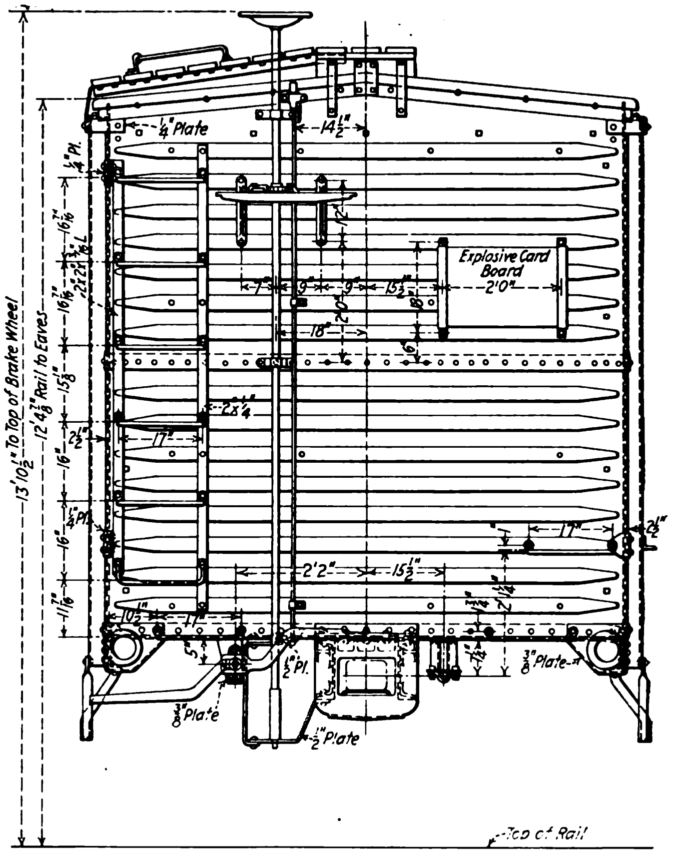
of grain doors have to be returned from tidewater to the Great Lakes in shipping any amount of grain.

General arrangement and details of construction

The underframes are of openhearth steel throughout The center sills consist of two 12-in. A. R. A. standard 40.3-lb. special rolled channels, reinforced by a ¼-in. by 20-in. top cover plate.

The body bolsters are of the built-up design consisting of two ⅜-in. diaphragms, extending from the center to the side sill channel and spread 7½ in. between the webs. They have a steel filler casting between the center sills. These are all connected together and reinforced by ½-in. top and bottom cover plates.

The side sills are of 7-in., 16.4-lb. channels and have angles riveted to the outside faces. The end sills are of 5-in. by 3-in. by ⅜-in. angles and are riveted to the



End view of the D. L. & W. box car showing arrangement of ladder, grab irons, etc.

side sills, diagonal braces and center sills. The body framing consists of 3-in. Z-posts and 3-in. Z-braces riveted to the top plate gusset and side sill.

The cars are equipped with Murphy corrugated steel ends which are made in two sections, the upper section being 3/16 in. and the lower ¼ in. thick, with substantial gussets extending back over the outside sheathing.

The siding is Douglas fir, 13/16-in. thick, dressed on both sides, tongued and grooved. The end and side lining is of the same material, also tongued and grooved, extending from the floor to the top of the car and all secured to 2½-in. by 2-in. fillers bolted to the corrugations of the steel ends. The 2¼-in. thick by 5¼-in. face yellow-pine flooring is tongued and grooved and extends to the outside edge of both end sills. Steel threshhold plates are applied in each door.

The Hutchins dry-lading roof made of No. 16 gage steel is used and is supported by pressed steel carlines.

The latitudinal running boards are of Douglas fir, dressed on one side to 1⅛ in. thick and applied rough side up. The longitudinal running boards are of three planks, 6 in. wide by 1⅛ in. thick, dressed on one side and applied rough side up. They are secured to pressed steel saddles by ⅜-in. carriage bolts.

Single side Camel No. 27 doors are used which provide an opening of 6-ft. They are steel bound, top hung, equipped with Camel combination door stop, lock and door closing and starting device.

The cars are equipped with 55-ton Bettendorf 5-ft. 6-in. wheel base trucks, with U-section cast steel frames. The journal boxes are an integral part of the truck frames, and conform to the A. R. A. standard dimensions for 5½-in. by 10-in. axles. The Barber lateral motion device and Woods tip roller side bearings are incorporated in the truck design. The truck bolsters are of the cast steel type. The ends of each bolster are provided with three rollers of cold rolled steel 2 in. in diameter and 10 in. long. The combination roller seats and spring caps are of drop forged steel. Davis cast steel wheels are used, which reduced the light weight 1,200 lb. per car.

The draft gear is the Cardwell type G-11-AA and the A. R. A. standard Type D coupler with a 6-in. by 8-in. shank is used. The couplers are equipped with 18½-in. pocket Universal cast steel yokes. The uncoupling device is the Carmer type. To prevent the coupler yoke cross key cotters from shearing off, which is so prevalent with the Type D key couplers, the D., L. & W. has designed and patented a key fastening, shown in one of the illustrations, which takes the strain off the cotter. It has four and one-half times greater shearing resistance than the ⅝-in. U bolt used on the A. R. A. cars. This fastening has eliminated cross keys from working out.

The air brake equipment is the Westinghouse quick-action, automatic Schedule K. C. 1012, with K-2 triple valves, 10-20 retaining valves, duplex spring loaded; Creco four-point brake beams with safety supports, with Schafer pressed steel bottom connections and drop forged U-type self-locking hangers are used. All the air brake pins and top brake beam hanger pins are equipped with positive brake pin locks manufactured by the Illinois Corrugated Metal Company. The hand brakes are connected direct to the brake cylinder push rod with a Universal booster introduced in the hand brake rod attachment to develop a pressure equal to the nominal air brake pressure. The Vissering perforated malleable iron brake step board is used.

Report of car inspectors' and foremen's convention

Abstracts of papers on grinding cast iron wheels and prevention of transfers and claims

FOLLOWING are abstracts of the discussions on the papers on lubrication and a progressive system of freight car repairs which were published in the October, 1925, *Railway Mechanical Engineer,* page 627. Abstracts of a number of other papers and discussions presented at the twenty-fourth annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association of America, which was held at the Hotel Sherman, Chicago, September 22, 23 and 24, are also published in this issue.

Discussion of paper on lubrication

A. H. Herbster (N. Y. C.): The New York Central has a number of dope reclaiming plants and it is surprising the dirt, grit and foreign matter that you get out of the dope that we have not been able to get before, and we certainly agree that the dope is kept in better shape and is better for re-use than it has ever been before. We have found that the waste from the paint and machine shop is not suitable for re-use.

F. W. Trapnell (Kansas City, Mo.): It was stated that in passenger and locomotive equipment, it was necessary to use wool fiber. In freight cars you can use cotton waste of fiber.

M. P. Cole (B. & M.): We are cleaning all the new axles and new journals which we apply, removing all the foreign substances on that journal, applying a little free oil, and making sure that the journal which we apply has a crown bearing. On passenger equipment, one year ago we started to jack all passenger equipment twice a year, in the fall and in the spring. We were obtaining 197,000 miles per hot box, in the passenger service, at that time, and last month we obtained 460,000 miles per hot box.

C. J. Nelson (C. I. I., Chicago): I think one of the first considerations involved in connection with this subject of lubrication, is the use of good material and that means waste, oil, and your bearing surface. It is unfortunate that the selection of the material to be used is not always in the hands of mechanical men. Making a roll too compact is liable to result in an early glaze, and some railroads have had bad results from that practice. One of our worst enemies is the glaze, and it cannot be destroyed without removing the packing from the box. The poor car inspector is to blame for it, but our lubricating expert says "poor oil." The solution is, first class attention and the only way to provide such attention is to arrange more frequent repacking of cars and then get the cars on the repair track so that you can do the work more efficiently.

H. Andrews (N. Y. C.): I was at a session some years ago when you gentlemen were in favor of checking up and inspecting journal bearings once a year, you did well for awhile and then you came to the idea that keeping the cars moving over the railroad was all that was necessary and would accomplish the purpose. If you will go out on the repair tracks and check up after the men whose duties are to properly care for the repacking of journal boxes I am quite sure you will find that if more attention was given to the brasses the cause for many of the hot boxes you are having would be found, and you will come back to this convention next year with a different theory and different ideas. You are not changing the journal bearings, gentlemen, and that is contributing to the cause of the hot boxes.

Discussion on progressive system of freight car repairs

H. Andrews (N. Y. C.): I would like to know if this program is outlined on a day work basis and just what checking up is done.

F. A. Starr (C. & O.): We are working on a day work basis and our production is superior than when we work piece work.

W. P. Elliott (T. R. R. A.): I recall at our last convention we had some discussion on the best way to cut out rivets. At that time I expressed myself as being in favor of the burning out process, but since that time I have changed my mind, I do not believe in the burning out process. I believe that there are rivet busters now on the market far superior to any burning process, that is for rivets ⅝-in. or ¾-in. I believe that we would not find it so satisfactory for rivets larger than ¾-in. The greater part of our work in rebuilding cars is on ⅝-in. rivets and our machine now in use is far superior to the burning process.

It is cheaper than the electric burner and the acetylene torch. It costs 1½ cents to cut out rivets with the burner and with the rivet busters we can do it for one cent.

F. S. Cheadle (R. F. & P.): With a shop program like the C. & O. there always will be a difference of opinion as to the best method of removing rivets, whether by burning or cutting, acetylene or electricity. I can absolutely agree that the burning process used by the C. & O. is superior and cheaper than anything I have come across.

E. G. Chenoweth (C. R. I. & P.): I find from my own experience that you should have a good man to deliver material and have in the organization such conditions in which you can return the material not used to the place from which it comes. In moving the cars the tendency is to deliver more material than is used. The effort we have put forth at this time to get this material back again to our storage place has been gratifying and has helped us a great deal, the fact that good material is strewed around cars and is not used is not only due to the man who delivers the material but due to the effort on the part of the workman that save some of the old material that may be still on the car.

One other thing that I want to bring up is the stripping of cars in order to get the rubbish all on one side of the yard. We have set aside two or three tracks for stripping cars for heavy repairs. The car is then moved onto the repair track and this keeps lots of the rubbish away from our repair track and we can concentrate our efforts for stripping at other points. We are working general piece work and I have found that we use about 10 men to strip cars on an average. Piece-work changes with the education of man on repairs, and I was surprised at the statement made today that they found they could get the work out faster in day-work than in piece-work. This has been entirely different in our experience in the past few years, and we have some interesting figures that have been worked up along this line.

We cannot, in a general repair plant, order material so far ahead as outlined in the paper today. We have to adjust ourselves to what is coming in and to the equipment that we may be required to handle. Complications may come up, therefore we have to work very close to the stores department, keeping them advised in advance as to what will be required. In doing this sometimes we have to wait, holding up equipment for a few days waiting for material to come, but it is found by most railroads that this is satisfactory, instead of getting a large amount of material in stock that possibly will not be used for some time.

In routing of cars and delivering material our foremen make out the list when the car comes onto the repair tracks. The foreman who has supervision over making repairs to the cars has nothing to do with the stripping but as soon as cars come onto the repair track he puts out slips for men to deliver material to the particular car. This class of material lies alongside of the track about where we expect to do this class of repairs. We have tried out both moving the men and moving the cars and as near as we can find by making a careful study there is not much advantage one over the other, but I personally would recommend moving the cars instead of the men due to the fact that your material can be put on the side of the track where you expect to use it.

Another thing that comes up in classified work which I was in hopes would come up here today is in arranging a piece work schedule for classified work. That is one of the hardest things to do, due to the fact that a man becomes expert in one class of work and naturally his pay begins to go up. In the beginning he started out satisfactory, this shows that when you classify work on piece work it means pay begins to go up as the man becomes expert in the work to which he is assigned. In this connection I have tried another scheme. We have four different divisions in our shop, of from 50 to 60 men. Each foreman in that department doing the same class of work. Instead of having an expert on each of these divisions or in each part of shop, we have men who do this all over the yard, for instance, like underframes or setting of the roof, etc. In a large yard this would work out all right, but as said before you run into the same thing as piece work; a man becomes expert and you may have to consider schedules again and as many of you know it is not a good thing to consider decreasing piece work prices.

Mr. Elliott: I want to say that I agree with Mr. Chenoweth and disagree with Mr. Starr. I don't think he meant what he said when he said he was getting more work on a day work basis than on piece work.

Mr. Starr: I do not say we are getting more work, I did say that we consider that we are getting more satisfactory results. The contention that piece work makes greater experts of men has not been proven in practice on railroads. We are doing equally as well as under the day work system and are doing it with less supervision, and our men become experts and strive to surpass each other in the quality of their work which must not be sacrificed for quantity.

I do not by any means wish to convey the idea that we have on the ground enough material to last through the year, but we do not start on the program until sufficient material is on hand to carry on the work until other material is received. We keep the stores and purchasing departments advised as to what we expect to do during the year and the material required to carry through the schedule, outlining to them just how, when, and in what quantities material should be delivered to us during the year.

The moving of the cars to the men as compared with moving the men to the cars has not been satisfactorily threshed out so far as railroad shops are concerned, where the shop is not equipped with overhead cranes, especially where cars must be moved by switch engine or by being pinched. When moving the cars to the men quite often delay results on account of gangs or men waiting until the entire track is moved. If you can arrange the schedule so that each cut remains on the track until the close of the day and all switching done after working hours, this surely would be satisfactory, otherwise your men and gangs must wait for cars to be moved.

In removing the arch bars and annealing them any crack and defect is easily detected. When you turn out a

car every piece ought to last until it comes back again for general repairs. Regarding the box and column bolts, if the car is undergoing class repairs and the bolsters are replaced with new, the same procedure is carried out with the column bolts.

The trucks are the most important part of a car, and if you get trucks in good condition you will keep the car off the repair tracks, for about 90 per cent of the defects are due to faulty trucks.

With reference to using labor for repairing furnaces, we use a car repairer helper and there is nothing in our agreement that prevents us from doing so, however, any pipe work must be done by pipe men. What I meant was this, they fill the furnace with fire brick and fire clay so that the oil and gas which we have will heat the rivets.

Mr. Andrews: Is it necessary to anneal the arch bars? In case the box bolts and column bolts are in condition that they might be left in the car, would it be necessary to anneal them?

Mr. Starr: I do not see any objection to annealing arch bars if they are in condition to go back in the car. I do not know where anything could be gained or lost by annealing the bolts, if a bolt is cracked under the head it could be detected easily.

Grinding cast iron wheels

By W. M. Allison

Traveling car foreman, D. T. & I., *Detroit, Mich.*

In the 1924 report of the Wheel Committee of American Railway Association it was strongly recommended that the practice of grinding slid flat cast iron wheels should be adopted as a standard practice of the Association. It was also recommended that the Arbitration Committee give due consideration to the practice and see that changes were made in the rules giving recognition to the ground wheel as a proper wheel for application to foreign cars.

The Detroit, Toledo & Ironton, together with a number of other railroads in the country, have purchased wheel grinding machines and have made extensive tests as to the safety as well as the practical and economical phase of the use of such wheels and it has been proved beyond a doubt that this is an item which would be a great saving to all railroads and can be done successfully without damaging the strength of the wheel in any particular, in fact greatly increases the life of a second hand wheel.

The practice of regrinding cast iron wheels has been in effect on the D. T. & I. for the past two years and before the grinding machine was put in every conceivable test was made from a practical as well as a safety standpoint.

Various manufacturing plants were visited where cast iron wheels were made and wheels examined which had been broken for test purposes. In no case was the chill less than 5/8 in. in depth, and as the A. R. A. has a minimum of 1/2 in. on new cast iron wheels flat spots of from 2 1/2 to 3 1/2 in. can be easily ground out without affecting the chill in any manner, in fact some of the roads grinding wheels claim that even 4 and 4 1/2-in. flat spots can be ground out.

In selecting wheels for grinding we are governed by the condition of the flange, tread and size of slid flat spot, choosing only such wheels that will retain the proper flange height and thickness, as well as proper diameter and hardness.

In our practice of regrinding wheels, owing to the small size of flat spots existing on those re-ground, we have never had to take off more than 1/16 in. to 3/32 in. to clear off the outside defect. The wheels are then given the Brinell hardness test which will show whether or not the wheel is affected by the process and it was found that the Brinell test shows the wheel slightly harder in most cases after grinding than it was before; however, in some few cases the Brinell reading is a little lower as will be shown by the following figures on 10 wheels on which the test was made.

Tests of chilled cast iron wheels

Wheel No.	Brinell hardness: Before grinding	After grinding
1	358	403
2	339	381
3	387	363
4	358	405
5	358	392
6	358	429
7	352	423
8	363	392
9	363	411
10	363	360

About two years ago the D. T. & I. had a pair of cast iron wheels cast in 1911 with a slid flat spot 2 1/2 in. which we re-ground and placed under one of our cars. These wheels have been in service since that date. We recently made an inspection of this pair of wheels, which incidentally are still traveling under the same car, and after two years of continuous service are still in good shape.

The machine which we use grinds both wheels at the same time and not only takes out the flat spots but takes out all imperfections or rough spots in the thread of the wheel, making them perfectly round, therefore making a perfect rolling surface which no doubt will in a manner prevent slid wheels and insure the smooth running of trucks.

We have had representatives from various railroads visit our plant and see the machine in operation and we believe that they are thoroughly convinced that this practice not only gives a second hand wheel but gives a far better wheel than the average run of second hand wheels; in fact, we believe that the average re-ground cast iron wheel is as good as a new cast iron wheel as far as the length of life is concerned.

Owing to the great saving which can be made by all railroads by adopting this practice, we believe that the members of this Association should make a careful study of the practice and recommend the adoption of such on their respective lines.

In regard to the charges for such work owing to the cost of installation of the machine required, provision should be made whereby the roads would be allowed to charge a reasonable amount for the reconditioning of such wheel and we understand that this phase is being considered by the Arbitration Committee at this time.

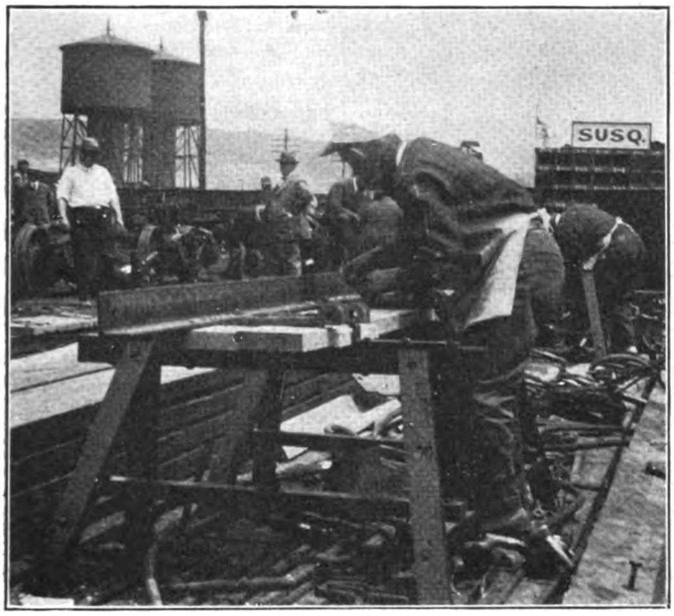
The object of bringing this matter to the attention of this Association is to get every man interested and educated to the great saving which can be effected.

A convenient horse for the wood worker

THERE are many jobs around a wood mill, such as the assembling of doors for wooden hopper cars, doors for refrigerator car hatches, etc., that require the boards to be drawn tightly together for the application of strap hinges and metal braces. Many wood workers use extension clamps for this job. A quicker and simpler method of doing this kind of work is by the use of the horse shown in the illustration, which shows one of the wood workers on the Susquehanna division team, winners of the car building contest held by the Delaware & Hudson

at Carbondale, Pa., May 21, 1925, assembling a bottom drop door for a composite hopper car.

Two pieces of wrought iron bar about ½ in. by 1¼ in., each having one end turned up at 90 deg. to a height of about 1½ in., are bolted to the top of the horse. The turned up ends serve as bearing surfaces for the wedges.



Assembling a bottom hopper door—The boards are drawn together by wedging them between two lugs on each of the horses

The boards for door are laid on the horses, as shown in the illustration, between the two wrought iron lugs. After the boards have been properly lined up, the wood workers drive a wedge between the lug and the edge of the door, drawing the boards together. He then proceeds to apply the bottom angle and hinges.

Educating car inspectors on the C. & E. I.

By R. E. May

District car foreman, Chicago & Eastern Illinois, Salem, Ill.

THE following outlines for the most part the method of educating car inspectors on the Illinois-St. Louis division of the Chicago & Eastern Illinois, which is quite similar to the method used over the entire system. On this division there are four car shops at intervals, each having three shifts of car inspectors and oilers employed in the train yards. At each of 21 other outside points from one to three car inspectors are employed.

Each month a list of 20 questions is compiled on A. R. A. rules, loading rules, safety appliance rules and Bureau of Explosives rules (the questionnaire effective March 1 was extended to include billing rules), these questions being sent to each inspector, foreman, and A. R. A. clerk on the division with instructions to answer them, give the rule reference, and mail them back to the district car foreman's office not later than the third of each month. There they are gone over carefully by the foreman and graded and a record kept of each man's grade. Correct answers, attached to each list of questions, are returned to the men, a typical set of questions and answers being included in this article.

During the month following, educational meetings are held at various points on the division as follows: Salem yard, Villa Grove yard, Mitchell yard, West Frankfort yard and Cypress. In this manner practically all car inspectors are enabled to attend a meeting at which the questions, used as a subject, are analyzed and discussed so that each man gets a thorough understanding of them. In addition, all inspectors are asked to bring up any questions pertaining to interchange, loading, billing, etc., of which they are in doubt, and these are discussed and a decision made. The office in which the meeting is held is supplied with a blackboard 16 in. by 48 in., lined to represent a billing repair card. During the month preceding the meeting a number of errors found on original records of repairs made by inspectors during that period are sorted from the files, and brought to the attention of those in attendance at the meeting.

First, the record of repairs is placed on the blackboard as improperly written by the inspector. The men are then asked to take exceptions, and usually one man is asked to come to the board and write the records properly. Thus all concerned may profit by the errors of others, knowing at future times how records of repairs covering certain limits, should be written. If any questions come up at the meeting which cannot be answered they are referred in writing to the A. R. A. committee of the Chicago Car Foremen's Association.

To test the thoroughness with which the inspectors' duties are understood and put into practice, periodical checks are made on original records and repair cards, the mistakes found being called to the attention of the inspectors responsible so that in the future they will not be likely to make the same mistakes. This plan has been successful in promoting interest and also familiarizes the inspectors with the rules, for, while they are looking up the answer to one question, they are reading the answers to several others. This plan can also be extended to cover instruction in air brakes, steam heat and various other subjects of vital importance to the successful railroad operation.

The men at and in the vicinity of Salem yard have recently organized, elected their officers in the regular manner, and assessed a small sum for dues. The money obtained in the form of dues is used in providing a meal, cigars, cigarettes, etc., for all who can attend, thereby enabling the men to enjoy a social time and get better acquainted with each other. The secretary draws up the minutes of each meeting, outlining all decisions which have been made on various questions, also outlining in the proper manner repair cards or records which have been discussed. These minutes are briefed as much as possible, mimeographed, and a copy sent to all concerned on the division. The minutes of each meeting held at Salem yard furnish additional material for discussion by inspectors who attend the meetings at other terminals. Thus far this system has been very successful and apparently beneficial to all concerned. By keeping a record of the grades, we know the men who need the most training and in the meetings these men are encouraged to ask questions and are given particular attention. In every instance they are just as eager to learn as we are to teach them.

Typical questionnaire submitted to C. & E. I. car inspectors February 1, 1925

Name, John Doe. Occupation, Car Inspector. Station, Salem Yard.
February 1, 1925.

Q. 1—Is equipment stenciling required on cars for certain details such as Type D couplers, K-1 or K-2 triple valves, when the stenciled date built definitely establishes the standard of car?..............

Q. 2—Who is responsible for defects caused by sudden stop due to emergency application of air brakes or bursting of air hose?............

Q. ?—Is it necessary to stencil cars equipped with D type coupler in order to protect them against substitution of the old style M.C.B. coupler?..............

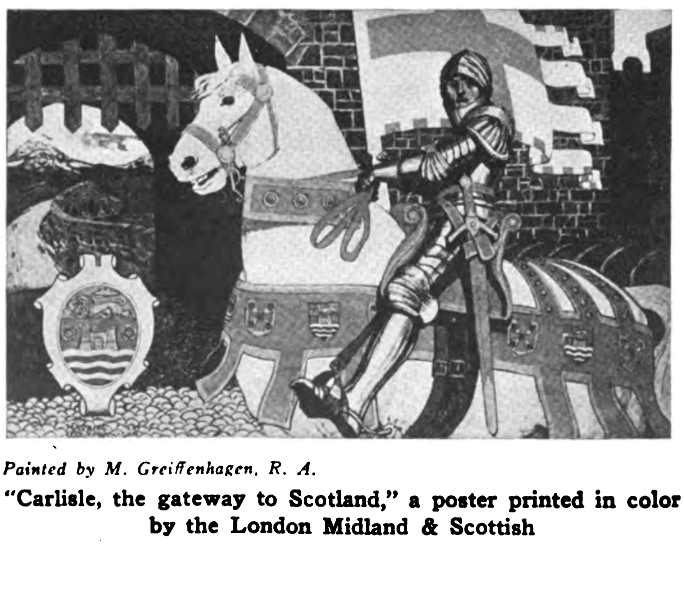
Q. 4—If you received in interchange a car that was being shipped home, loaded on another, on special authority of the owners, for repairs to owners' defects, would you issue defect card for missing material and the labor necessary to repair same?..............
Q. 5—Is it permissible to paint over inflammable placards on empty tank cars when they cannot be readily removed by scraping or soaking?..............
Q. 6—Can lading be placed on top of box or stock cars?..............
Q. 7—What should be done to permit placing load on top of sides on drop end gondolas?..............
Q. 8—Is it permissible to use wooden flat cars having only two truss rods for twin or triple loads?..............
Q. 9—What should be done when necessary to make the width of lading less than width of car on account of long overhanging, or distance between bearing pieces?..............
Q. 10—How many pairs of stakes are required on single overhanging loads, on carrying car; state location? (piling, logs, telephone poles, etc.)..............
Q. 11—What kind of a hand brake must a freight car be equipped with to comply with the law?..............
Q. 12—What is the minimum diameter for side hand holds?..............
Q. 13—Is the handle of an uncoupling lever which is 14 in. from side of a car (freight) a violation of the law?..............
Q. 14—What kind of a car must be equipped with vertical end hand holds?..............
Q. 15—When single uncoupling lever is used, on which side of the end of the car must it be located?..............
Q. 16—Should packages containing inflammable liquids be entirely filled? ....
Q. 17—How long must charcoal which has been burned in pits or kilns stand in open kilns, or air, before being loaded in a freight car?..............
Q. 18—Is it necessary to place caution signs on track when unloading tank cars on railroad property?..............
Q. 19—When dangerous articles requiring the red label are shipped in the same outside package with dangerous articles requiring yellow or white labels, how should package be labeled?..............
Q. 20—How should interior packages containing corrosive liquids be packed?..............

The above questions are based on the A. R. A. rules, loading rules, Safety Appliance Laws, and Bureau of Explosives regulations. They should be answered by all foremen and inspectors at outside points and terminals, including all men working in train yards, and sent to this office before February 1, if possible, and not later than February 3. All answers should be made as brief as possible and where possible, show rule reference or page number in rule book where answer is found. These questions and their answers will be discussed at the educational meeting to be held in the office of the car foreman at Salem yard, Thursday evening, February 19, 1925, at 6:30 p. m.

R. E. May,
Dist. Car Foreman.

Answers to monthly questionnaire dated February 1, 1925

A. 1—No. A. R. A. Rule 17, interpretation 17
A. 2—Owner's responsibility except as otherwise provided for in Rule 32. Emergency application from rear of train, however, is unfair usage. A. R. A. Rule 32, interpretation 5.
A. 3—Yes. A. R. A. rule 17, interpretation 2.
A. 4—No.
A. 5—Yes. A. R. A. Rule 36, interpretation 6.
A. 6—No. Loading Rule 11.
A. 7—Corner stakes must be suitably reinforced. Loading Rule 9, paragraph F.
A. 8—No. Loading Rule 20, paragraph B.
A. 9—Filling pieces must be placed between the stakes and lading, and securely fastened to inside of stakes. Loading Rule 119.
A. 10—Five pairs. Three pairs should be placed near the bolster at the overhanging end, and two pairs at the opposite end. Loading Rule 132.
A. 11—An efficient hand brake.
A. 12—5/8 in.
A. 13—Yes.
A. 14—Full width platform end sill car.
A. 15—Left side.
A. 16—No. Paragraph 405, page 47, Bur. of Expl. Regulations.
A. 17—Not less than 24 hours. Paragraph 463, page 56, Bur. of Expl. Regulations.
A. 18—Yes. Paragraph 1050, page 110, Bur. of Expl. Regulations.
A. 19—Red label only. Paragraph 309 (f), page 37, Bur. of Expl. Regulations.
A. 20—With the filling holes up. Paragraph 522, page 63, Bureau of Expl. Regulations.



Painted by M. Greiffenhagen, R. A.

"Carlisle, the gateway to Scotland," a poster printed in color by the London Midland & Scottish

Dolly bar for bucking up rivets

ONE of the devices used in the recent car building contest held at Carbondale, Pa., May 21, 1925, by the car department of the Delaware & Hudson, which attracted considerable attention, was a lever dolly bar used by a riveter on the Colonie team. As shown in the illustration, the riveter is able to hold a rivet and buck it up at the same time. This eliminates the services of a second man to perform the work of bucking up.

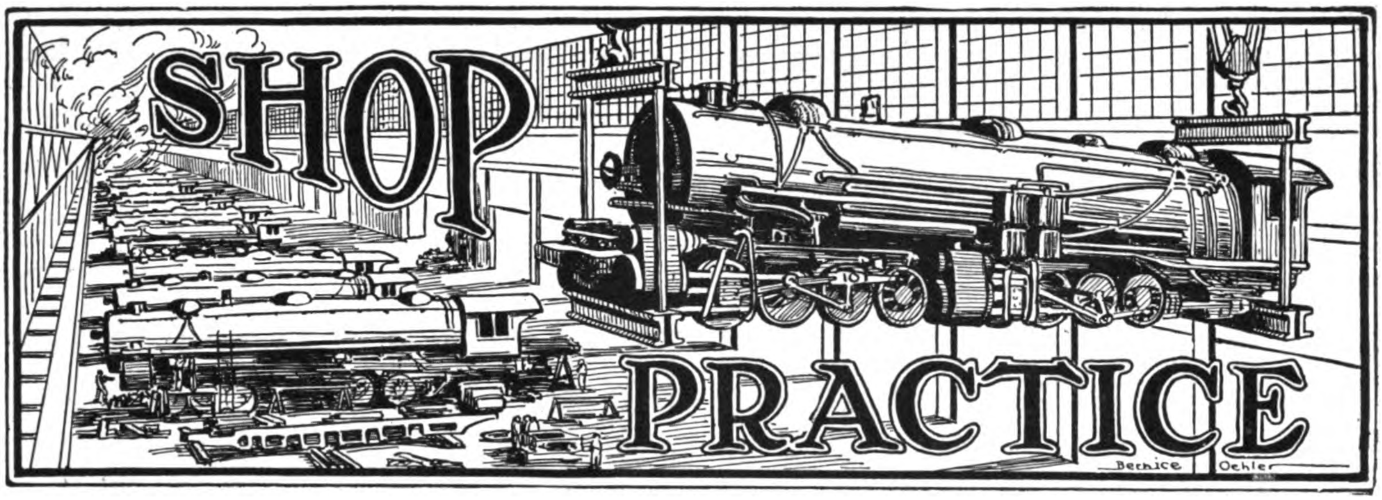
The device is made of steel bar about ½ in. by 1½ in.

Steel worker driving a rivet and using the lever dolly bar for bucking up

One end is constructed to hook under the flange of the center sill channel and the opposite end provides trunnion bearings for a dolly lever on the outer end of which the riveter places his foot. The pressing down of this lever forces the rivet up tight into the hole and at the same time brings the top cover plate down tight against the flange of the center sill channel.

THE CHINESE GOVERNMENT railways have adopted uniform accounting for their shops. The charges have been divided into two categories, power and general. In shops where absence of electric or steam meters prevents accurate distribution of power costs, machines are to be given a horsepower rating and the use of such machines will be timed in the same manner as time is kept for labor. General charges and power charges are first debited to respective suspense accounts, which accounts are cleared by fixed rates per machine horsepower hour and fixed percentages on labor costs as jobs are completed. These rates and percentages are to be revised as necessary in order to maintain balances at a minimum, due allowance being made for seasonal fluctuations.

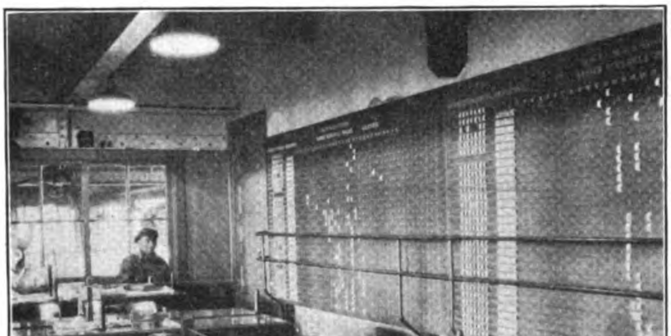
Foundry costs are treated similarly, the foundry suspense account being cleared as good castings are delivered at a uniform rate per pound or per kilogram. Articles manufactured for stock or for other departments may thus be priced on delivery, thus avoiding one of the most serious difficulties in Chinese material accounting. Due to the limited education of foremen in shops, assignment of workmen to jobs is to be accomplished by means of boards upon which the job number is chalked, under which workmen's number checks are hung. Timekeepers will record these assignments four times daily, broken time to be estimated in consultation with foremen. An attendance record is made out by a similar process at the entrance gate and the two records, one in the shop and the other at the gate, are to be compared daily.



Some impressions of Burnham locomotive shop

Improved morale evident at new D. & R. G. W. shop—Effective routing and material delivery systems—Time saving shop devices

THE new locomotive shop of the Denver & Rio Grande Western, located at Burnham on the outskirts of Denver, Colo., and described on page 491 of the August, 1924, *Railway Mechanical Engineer*, holds much of interest in the way of modern equipment and effective shop methods, developed since it was placed



Interior view of formen's office showing glass top desks and master schedule board with guard rail on the wall

in operation about 15 months ago. In common with most railroad shops during this period, Burnham has not been forced to anywhere near its maximum productive capacity and consequently a comparison of the locomotive output, before and after the erection of the new facilities, would hardly give a fair measure of their value. In spite of this fact, however, the output per man employed has increased substantially. The record shows that in 1923 the average number of men working in the locomotive department at Burnham was 521, the average output being eight heavy repair locomotives a month. For the first nine months of 1925 the average force employed in the locomotive department was 384 men, or a decrease of 26 per cent, the average output dropping to seven locomotives a month, or a decrease of only 12½ per cent. The 1925 locomotives received on the whole appreciably heavier repairs than those put through the shop in 1923.

Aside from the question of output, the visitor at Burnham shop will probably be most interested and impressed by its excellent design and construction, fine day- and night-lighting facilities, and the full complement of modern machinery, described in detail in the preceding article in the *Railway Mechanical Engineer*. Other points which may strike the attention are the exceptional cleanliness and order apparent in all departments of the shop, the high standard of morale evident among the men, the effective shop schedule or method of routing locomotives through the shop, and last, but by no means least, the shop delivery system which gets material from the stores department where needed, when needed and with the least possible delay.

While the importance of order and cleanliness may sometimes be over-emphasized, railroad shops are not commonly subject to that criticism. More often they are dirty and congested, even with an average output, and when a sudden demand comes for power and the shop is filled with locomotives, this congested condition becomes a serious handicap in any attempt to obtain the desired output. Doubtless Burnham shop will present a different appearance when every pit in the erecting shop is occupied by a locomotive undergoing repairs, and various parts of the machinery, boiler and accessories are scattered throughout the shop. The present orderly handling of the work, however, indicates that when the rush comes, Burnham shop will be in a position to handle

it with a minimum of confusion and lost motion. An important factor in keeping the shop clean is the "Clean Shop Banner" awarded weekly to the department which is in the best condition as regards order and cleanliness. This banner is highly prized and provides a constant incentive for each department to do better than its neighbor in the matter of keeping cleaned up and picked up.

Morale—activities of the employees' organizations

A high standard of morale is evident among the employees at Burnham shop and the friendly spirit of co-operation which exists between the supervisory officers and men means much in the way of better working conditions and more efficient shop operation. It may not be amiss to trace the development of this morale and mention some of the means used to foster it.

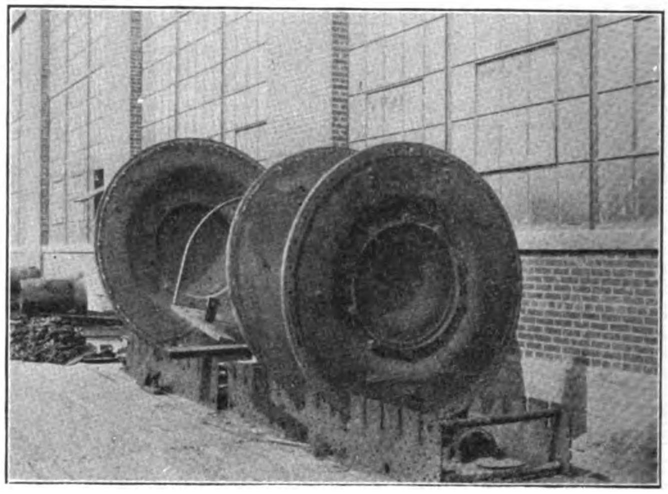
In the fall of 1922 the majority of the foremen at the Burnham shops of the Denver & Rio Grande Western were men who had been with the road a number of years and these, with a few of the older experienced men who acted as instructors, set the pace and standards of work for the new men as employed. Ample supervision was furnished to insure that the work would proceed in an orderly and efficient manner.

Local and system shop organizations were effected, to which the foremen gave their support, as it was quickly determined that with such organizations the foremen were able to direct operations efficiently and gain the interest of the men in producing desirable results.

The men, employed on probation, were naturally anxious to demonstrate their ability. A graduated scale of pay, based on ability, was put into effect with provision for an increase in rate when justified. Under this arrangement helpers are advanced to craftsmen. As there are two shops, one at Burnham and another at Salt Lake, identical in design and practically so in equipment, competition and friendly rivalry is stimulated on similar jobs and classes of equipment between the two shops. The men are interested in the superiority of their shops to the same extent that the supervisors are.

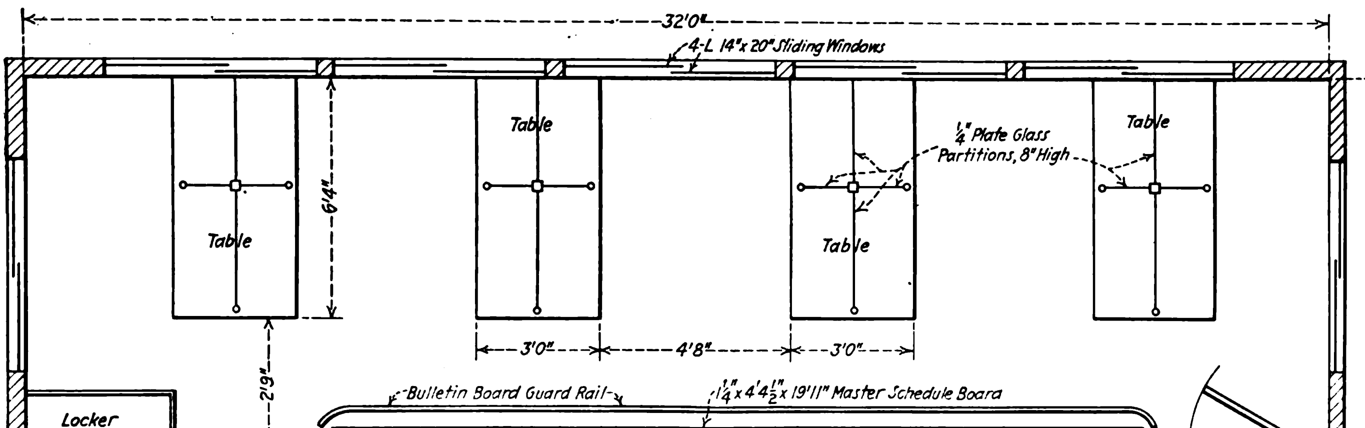
The terms of agreement between the Denver & Rio Grande Western and the mechanical department employees are given a fair interpretation and in cases of doubt are decided in favor of the men. In addition to the new shop buildings with their good heating, lighting and sanitary facilities, every effort is made to maintain desirable working conditions. Heavy manual labor is largely eliminated by the crane and hoist facilities with power tractors and trailers for the delivery system. In assigning men to work, consideration is given to their physical ability and so far as possible men are given work for which they have an aptitude and liking.

Suggestions made by the men are considered by the supervisory board and when adopted are put into service and credited to the originators. If used at other points, a drawing is made and credit given thereon. Grievances are taken up by the shop committee with the department foreman, the general foreman, or the general mechanical superintendent, if necessary, prompt action being taken to adjust any grievances found to be justified.



These racks save space in storing smokebox fronts

One of the most important activities of the employees' organizations is that of the Scenic Line Service Club at each division point, composed of employees and officials of all departments. This club helps cultivate better acquaintance of the members and furnishes an opportunity for talks by employees and officers on any subject pertinent to the interest of the company and employees.



All department foremen have desks in the centrally located general foreman's office at Burnham locomotive shop

A safety committee composed of representatives of all the shop departments meets monthly to consider all suggestions made regarding methods of eliminating unsafe practices and in this manner safeguarding the workmen. To take care of minor injuries and afford first aid in serious cases, an emergency hospital is located conveniently on the shop premises and contains a full complement of sanitary equipment. The rules require that every accident, no matter how minor, providing it involves a break in the skin, be reported in order that the wound may be properly

dressed. A mutual organization provides medical, surgical and hospital service for a small monthly fee.

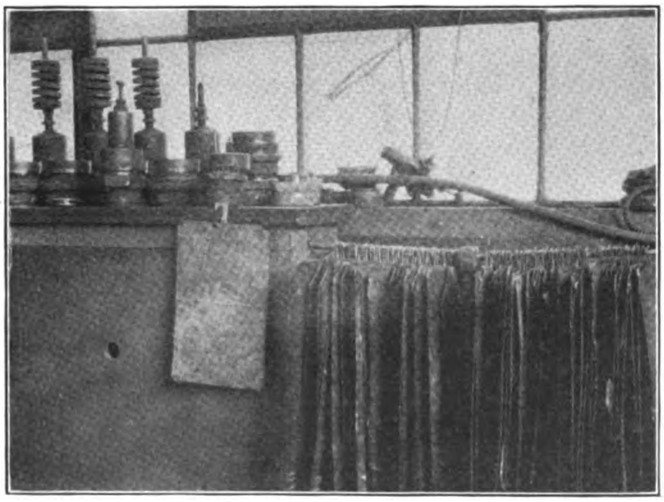
An important feature of the organization work is the stimulation of better acquaintance through various social affairs. The shop band, composed of shop and office employees, furnishes music at meetings, dances and picnics. The dances are managed by the men and held several times during the year. The picnics are annual affairs on each division, for which the transportation is

A departmental schedule board and telephone for ordering material and inter-shop communication

furnished by the company. In addition, inter-shop ball games are played between teams at different points.

The company magazine also is an important factor in encouraging loyalty to the company, containing as it does contributions from all classes of employees on any subject of interest, together with personals, special educational articles and records of accomplishments. There is also a crafts magazine published by the men.

The company encourages relief activities, a special



A convenient blue print rack in the brass room

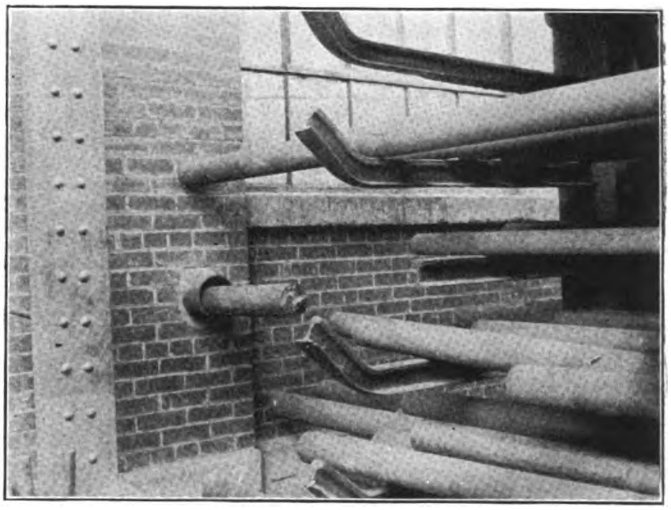
representative investigating needy cases and arranging relief through organized agencies. The pension system provides an annuity for employees reaching the retirement age.

Shop schedule simple and effective

The shop scheduling system which has been developed at Burnham shops is based on the system installed at the Silvis shops of the Rock Island and previously described at some length in these columns. Certain changes have been adopted, however, which seemed advisable to adapt it to local operations.

A master board is located in the general foreman's office, the engine numbers and dates being transferred to departmental schedule boards as required. When a locomotive enters the shop the general foreman sets the date for boiler test and engine wheeled, the schedule clerk then setting all the other dates.

The general foremen's office is also a general office for all department foremen in the plant, with a desk for each one as shown in the floor plan drawing. A meeting is held during every noon hour and a check made of the master schedule board with particular reference to any delays indicated by red tags. With all of the foremen present the cause of the delay can be quickly located and steps provided to take care of the matter. The arrangement of the foremen's office has proved very efficient. It forms a common center where they are all available to each other except during working hours. They are much less inclined to spend time in the office than was the practice when each had an office in his own particular section of the shop. The entire office is visible from the machine and erecting floors so that a man can readily be located



Bar stock for the turret lathes passes directly from the rugged storage racks through a hole in the shop wall to the machines with minimum handling

if he is in the office. At the same time, anybody in the office has a good view of the locomotive shop building.

With the work closely subdivided on the departmental board, each foreman watches to see that the work is delivered to him on time in order that he may get the full benefit of his allowance of time. On this account each man voluntarily traces on the department which handles the work ahead of his. There is no chance to "pass the buck" and fictitious alibis are easily exploded.

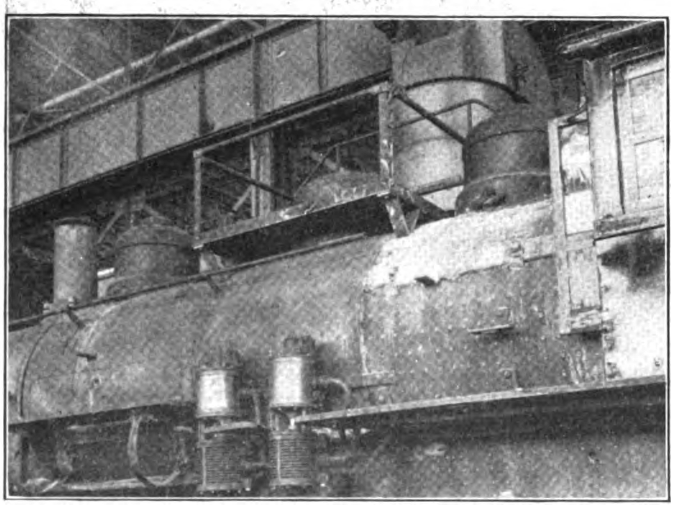
A four o'clock report of material delays, showing the locomotive or shop order number, kind of material, amount, pattern number and date ordered, has been developed which eliminates much waiting for material. It furnishes the shop with a quick record of the material situation, and the division storekeeper is reminded daily of the shop needs. The copy sent the mechanical engineer is checked by him and the general storekeeper in order to straighten out any weak points in the material supply situation. This also provides for furnishing material from other storehouses if available. A marked improvement has resulted in the material situation.

Material is not entered on the four o'clock report more

than once. In other words, if rivets are out of stock for three days the only four o'clock report on which this material shows is one made out on the first day the shortage was noted. The schedule man, before turning in the four o'clock report, checks it with the general foreman who notes thereon if any different arrangement has been made on account of the material being out of stock. In other words, if a casting is ordered and found to be out of stock and the shop makes a forging to do the work in order to keep the engine up to schedule, the general foreman notes this fact on the report. This shows the stores department that it is not necessary to order this casting specially for this engine even though it is out of stock. The stores department shows under the heading, "For store supply," the status of items reported out of stock, giving as nearly as possible the expected date of delivery. This information is entered on the report at once and the original copy returned to the general foreman the same day. The general foreman then goes over the report with other foremen interested so that everyone concerned is acquainted with the situation.

Prompt material delivery

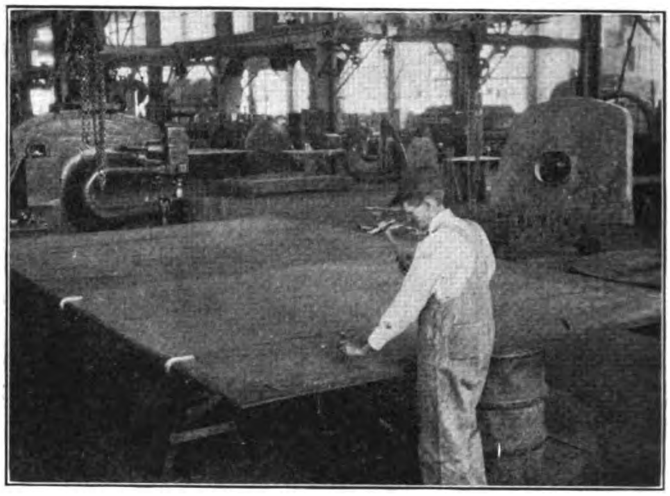
One of the important factors in the success of the Burnham shop operation is the arrangement made for prompt and efficient handling of material from the stores department to the various shop departments as required. In accordance with a practice which has come to be quite common in modern shops, the various steel columns or stations throughout the shop are marked with a combination of letters and numbers by means of which foremen can designate where they want material from the stores department left. At Burnham, however, the "pick-up system," or customary practice of leaving material orders at the various stations to be picked up and subsequently filled by a stores department material trucker on his regular rounds, has been discarded to the extent that orders are transmitted verbally. Telephones



Portable steam dome platform which facilitates throttle work and promotes safety

provided in each of the important shop departments enable the foreman or other authorized person to have immediate communication direct with a stores department switchboard devoted exclusively to shop delivery and attended by an operator who is an experienced stock man. Orders from all parts of the shop, therefore, come to this one switchboard and the operator either knows or can find out immediately whether the material requested is available and if not whether substitute material can be provided. The prompt transmittal of this information to the foreman over the telephone not only saves a great amount of time spent in writing orders for material not in stock, as well as many unnecessary trips between the shop and stores department but materially speeds up shop operations.

On receiving the verbal request over the telephone for material the shop delivery switchboard operator fills out the order or requisition which is taken together with the material to the shop by one of the material truckers who brings back the signed requisition on returning to the stores department. Power tractors with suitable trailers



Standard templets are used to save time in laying out boiler sheets

are used for handling material and besides saving manual labor, get the material to the shop with the least possible delay. Experience has shown that 15 min. is the average time required for the delivery of material orders with this system. A particular advantage of the telephones is that in case of emergency and where the material is in stock, immediate delivery can be obtained. Since installing this system and using power tractors and trailers, the force employed in trucking material at the Burnham shop has been reduced at least 50 per cent.

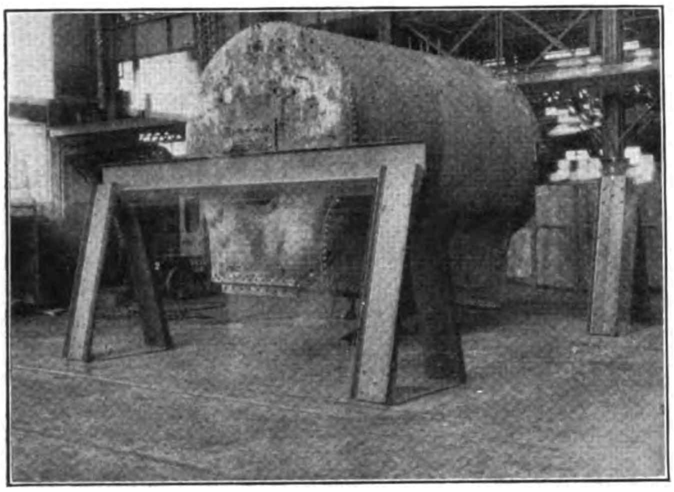
Labor saving shop devices

One of the illustrations shows a portable steam dome platform which has proved helpful in the handling of throttle work as well as in providing greater safety for the men who are doing this work. This platform consists of a built-up steel and wood platform 6 ft. square and having a hand or guard rail made of 2-in. pipe or flue material, 2 ft. 6 in. above the floor. A hole 3 ft. 9 in. in diameter is provided in the center of the platform, enabling it to slip down over the largest steam dome, most of the weight being supported by the platform floor resting on top of the boiler. Stability is secured by means of four V-shaped brackets, two of which bear on the barrel of the boiler on either side of the dome. The two brackets on the left are shown in one of the illustrations. These brackets are made of 5/8-in. by 4-in. bar stock, riveted to the platform floor. Two hooks are provided on opposite corners of the rail to which the crane chain hooks can be readily applied. They serve to lift the platform from the erecting shop floor onto the boiler or back to the floor again as may be required.

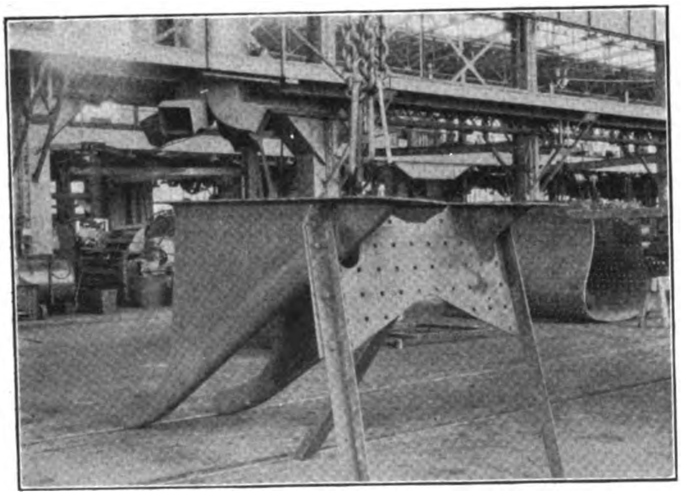
Solid and tubular bar stock of all kinds is kept outside of the locomotive shop in rugged racks built up of heavy timbers with horizontal rail sections and provided with umbrella type roofs as a protection against rain. When certain of this stock is required to be worked up in tur-

ret lathes in the shop it is passed directly to the machines through a hole in the shop wall as shown in one of the illustrations. This is merely a simple method of saving work in handling the heavy bars.

An effective method of handling shop blue prints is in vogue at Burnham. It consists of mounting commonly used blue prints on scrap sheet iron of standard sizes and hanging them on suitable racks. Shellac is used both to make the blue prints adhere to the sheet iron and as a surface protection against oil and dirt rendering the prints unreadable. A hook riveted to each sheet, as shown in one of the illustrations, enables the sheet and blue print to be suspended in its proper place in a compact rack in the toolroom or, when out on the job, from some part of a machine or bench where it can be readily seen. As a result of this method of handling blue prints they take up minimum space when not in use; any particular print may be readily found when required; durability is secured and blue prints when at the machines or work benches can be used with maximum convenience. The main filing rack in the toolroom consists of a substantial angle or T-iron supported on 2-in. by 4-in. diagonal wooden legs at a distance of 4 ft. 9 in. above the floor. Beneath the angle iron, and supported at about 12-in. intervals from it, is a ½-in. rod from which the blue prints are suspended by means of the hooks. When a considerable number of blue prints are used constantly on a particular job, as in the brass or air brake room, they are kept at that point on a small rack which may be placed in some corner where it will be convenient but out of the way.

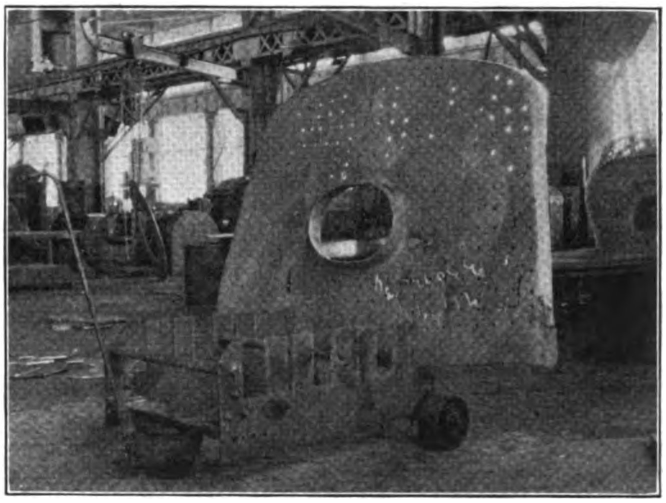


By means of this pair of horses, boilers can be rotated and blocked in position for boilermakers to work to the best advantage



A convenient stand for use in applying Nicholson thermic syphons

The problem of storing smoke box fronts is often difficult, particularly in a congested shop, and one of the illustrations shows how simply this is handled at Burnham. A rack built up of ½-in. or ⅝-in. scrap boiler plate, and having slots of suitable size and properly spaced cut with the oxy-acetylene torch in the upper edges of the rack, is located outside the shop building. After a smoke box front is removed from an engine in the shop for general repairs or other work involving the renewal of front end netting and parts, a storage battery truck with jib crane attachment picks up the smoke box front and carries it out of the shop, setting it down in a vertical position in one of the slots in the rack. By this means it is taken completely out of the shop which may be otherwise congested, occupies a minimum space while being stored, and moreover is set in such a position that there is no danger of workmen falling or tripping over it. It will be observed from the illustration that the two sides of the rack are held together by suitable tie rods, the proper spacing being secured by scrap tube sections of the proper length.



Completed or partially completed flue sheets are placed in this truck on which they take up minimum floor space and are readily moved about the shop

Templets are used in laying out standard boiler sheets saving an immense amount of time and assuring accuracy. Each templet when in use is clamped to the boiler sheet during the laying-out process to obviate any possibility of slipping while the center punch marks are being transferred through the templet to the boiler sheet. A complete set of templets is kept under the horses shown in the illustration.

The method of renewing fireboxes at Burnham is to strip and cut off the entire back end of the boiler, using an oxy-acetylene cutting torch. The back end is then taken to the boiler shop and supported at approximately its center of gravity on two horses as shown in one of the illustrations. The horses are built up of channel and I-beam sections riveted together and of sufficient strength to support the heaviest back end. The weight of the back end is transmitted through two trunnion plates to bearings on the horses and, by means of suitable blocks and a clamping arrangement, the back end can be held in whatever position may be most convenient for the boilermakers who are renewing staybolts, mud ring rivets, or other work. In other words, this arrangement makes it un-

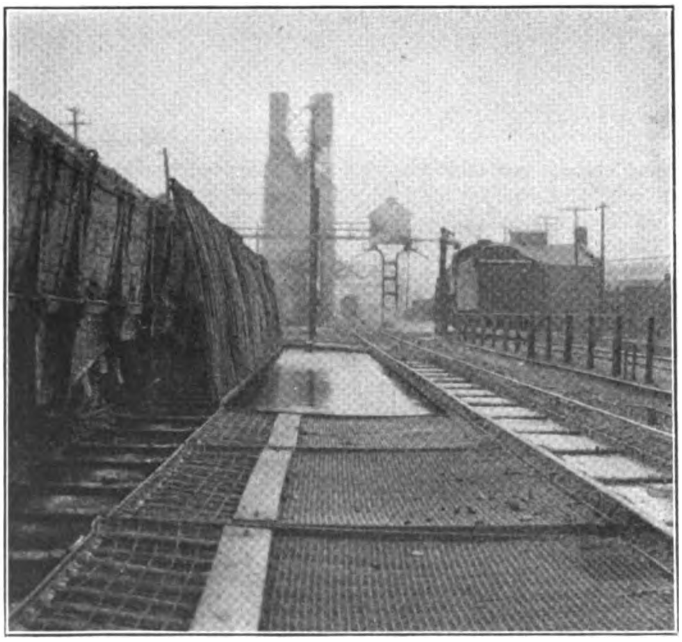
necessary for boilermakers to apply staybolts and rivets upward or at an angle which may make the work difficult. Any necessity of working in a cramped position or limited space is avoided.

The operation of applying Nicholson thermic syphons to boilers is somewhat awkward owing to the shape of the syphons and the rather limited room in which the boilermakers must work. The three-legged, built-up sheet metal stand illustrated has proved especially convenient for this purpose, there being slots in the upper part of the stand to hold the pair of syphons at the correct distance apart and approximately in the position they will assume when in the firebox. The boiler back end is then lowered down over the syphons, the upper edges fitted into the openings in the crown sheet and welded and the entire operation performed with much less difficulty than if the syphons had to be held in position entirely by hand.

A three-wheel truck, designed for holding and transporting various flue sheets and other boiler sheets about the shop is also illustrated. This truck consists of a substantial boiler sheet framework supported on three truck wheels and provided with slots of different widths cut with the oxy-acetylene torch in such a way that boiler sheets in various states of completion as regards forming the flanges, can be held upright in the truck. The sheets will in this way take up comparatively little floor space and may be readily moved about the shop.

Safety covers for water type ash pits

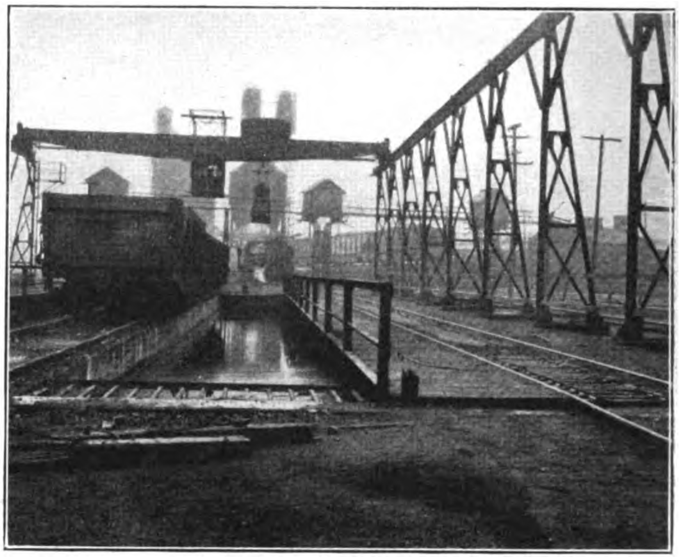
THE water type of ash pit which is quite commonly used at the majority of modern engine terminals offers many advantages over the older types of pits, but at the same time, presents an element of danger



The covers are supported against the cars and must be lowered before the cars are moved

which has proved to be quite difficult to eliminate—the possibility of ash pit men either falling in the pits or unconsciously stepping off the wrong side of a locomotive and into the pit. The two illustrations which accompany this article show two different arrangements installed at the Joliet, Illinois, engine terminal of the Elgin, Joliet and Eastern, that have successfully eliminated the dangers in connection with the instillation of an uncovered, open water type of ash pit.

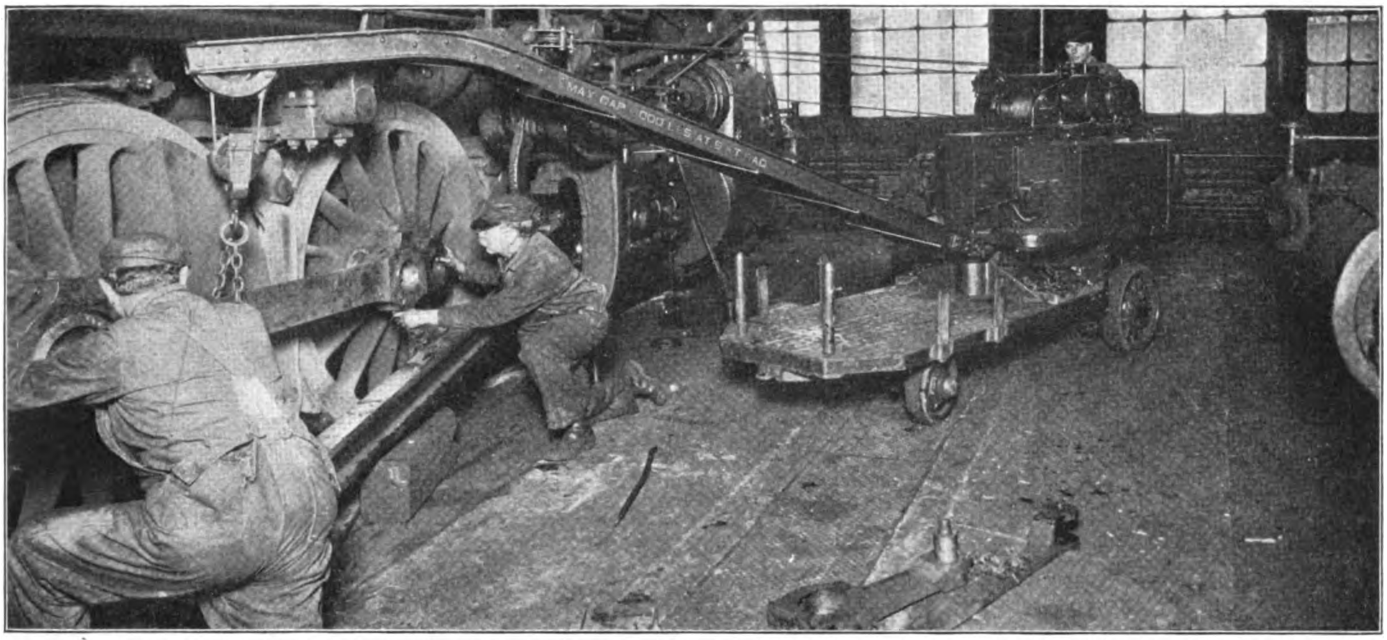
There are two ash pits at this engine terminal, one illustrated in each of the pictures. It will be noticed that on one of the pits a grating constructed of boiler tubes has been laid between the rails over the pit, and on the inside of the pit track towards the center or service track has been placed a runway with a railing, so that no matter from which side of the locomotive a man should



The runway on the pit side eliminates the danger of a man alighting from the wrong side of a locomotive

happen to alight, there is no danger of his falling into the pit.

The arrangement of the grating over the other pit seems to be still better. Many railroads throughout the country have devised gratings to be placed over ash pits of this type and it may be safely said that in the majority of instances, these gratings may be placed over the pits in such a manner that the operator on the ash pit crane may pick up the gratings and lay them on the ground while cleaning out the pit with the clam shell bucket. Gratings arranged in such a manner have one disadvantage in that it is very easy to neglect to replace them when through cleaning out the pit and, as a consequence, they fail to serve their purpose. The arrangement shown in the second illustration differs from the ordinary type in that the gratings are hinged to an I-beam support which runs along the pit adjacent to the center or service track so that when it is desired to remove the ashes from the pit with a clam shell bucket, these gratings are raised and must be supported against the cars on the service track. It can readily be been that it is almost impossible to move the cars from the service track after the pit has been cleaned without lowering the grating into place and in this way, the fact that they are hinged and rest against the cars serves as an automatic safety feature. The gratings themselves are constructed of light weight material principally a light angle iron outer frame and cross bars of 2-in. boiler tubes flattened at the ends and riveted to this frame. Over these cross bars is laid a close mesh netting and a plank runway. It will also be noticed that there are cross bars between the rails of the ash pit track which support a grating that is just beneath the surface of the water in the ashpit.



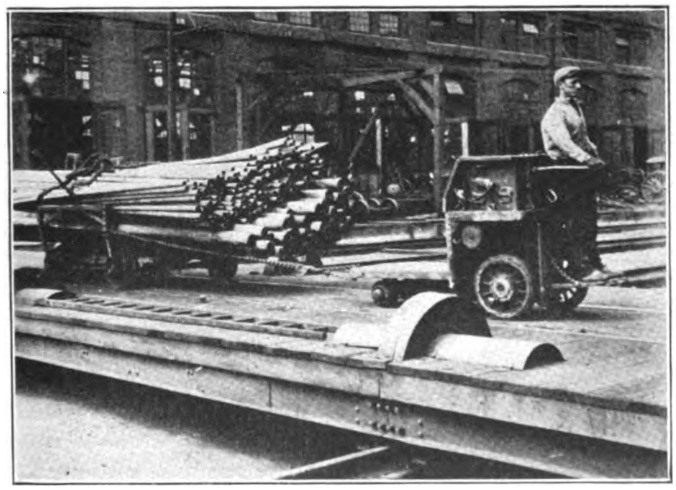
The crane type truck as it is used for applying side rods.

Electric trucks in the locomotive repair shop

The practice of one railroad indicates that this equipment fills a definite need

By Harold J. Payne
The Society for Electrical Development, Inc.

THE size of modern steam locomotives is so great and construction is so complex, that the problem of stripping and rebuilding requires special facilities. The overhead traveling crane is indispensable in this connection and given sufficient time, can handle all of the work to be done. In the particular shop in question, however, 40 locomotives are placed at a time in each of two buildings and although each building is equipped with two cranes, it is still found that this apparatus is not equal to the number of tasks imposed upon it. Since in addition to the boiler tubes, 125 or more parts have to be taken off and replaced on each engine that is completely overhauled, this can be readily understood.



An elevating platform truck used as a tractor

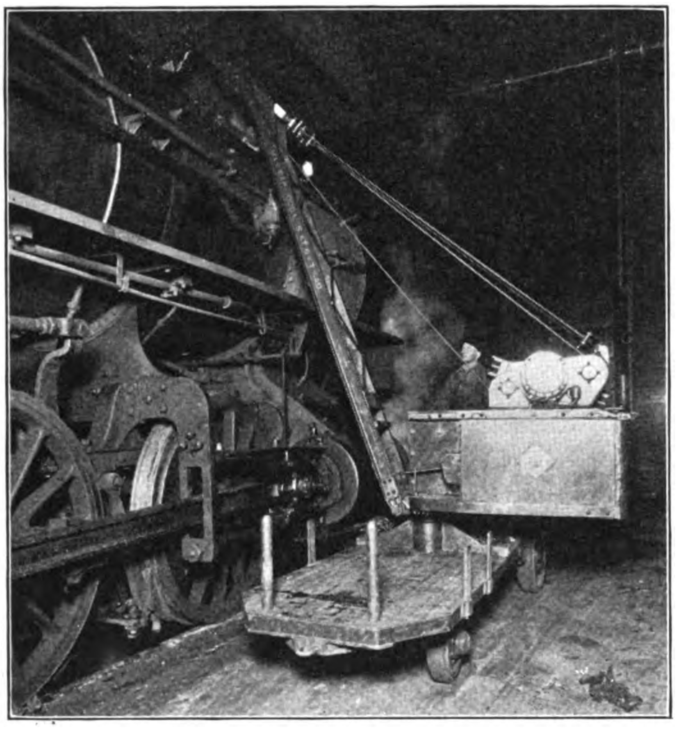
Another class of work for which it has very commonly been found difficult to find adequate equipment in such shops is the handling of parts from the locomotive to the various sections of the repair shop where cleaning machining, forging, annealing, etc., are done. Distances are frequently long, parts are heavy and are moving between points that vary considerably in location from hour to hour—especially as in this case where 80 locomotives are being repaired simultaneously. Quite evidently any carrier that is to work out in such service must be at the same time sturdy in construction and flexible in operation.

Storage battery trucks adopted

With these two problems in hand the shop under discussion decided about four years ago to experiment with storage battery trucks as a possible solution of these difficulties. The original idea was to provide auxiliaries for the heavy cranes and for hand trucks. That being the case two types of truck were put into the service, the load carrying crane and the elevating platform. At present the management finds itself convinced not necessarily of the particular make of equipment nor the particular modifica-

tion in use, but of the suitability of trucks for this kind of service. It can be said that each of the eight machines in service does more work than five hand truckers. The more or less intangible results that have been achieved, however are of still greater importance.

The most important of these is the supplementary service rendered the overhead cranes. Formerly when a part was ready to be raised or lowered, it was necessary for the crew to wait for the overhead crane; time was unavoidably lost since it was a physical impossibility for two such machines to be in a half dozen places at a time. With the crane trucks now performing all of the lighter jobs the traveling cranes are always available for the work for which they alone are fitted such as lifting a rear end or front end or perhaps moving a boiler. By far the larger number of parts stripped weigh under three tons and are located within easy reach of the boom of the crane truck. Consequently, this work has been largely assigned

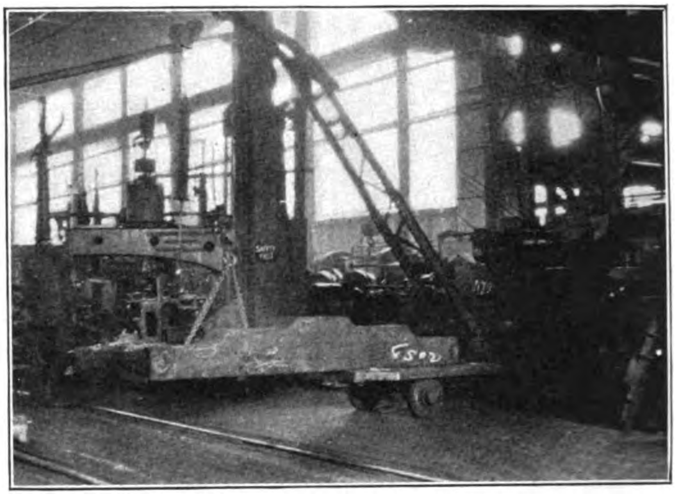


The boom is long enough to remove parts from the top of the locomotive

to these auxiliaries, with the result that taking down and building have been generally accelerated. Furthermore, idle time on the part of repairmen has been cut down and in some cases the number of moves necessary to perform a given job has been decreased. For instance, when a couple of driving rods are taken off that are needed immediately in the machine shop, the crane truck drops them onto the platform of its own chassis and delivers them to the machine that is to do the work, traveling a thousand feet and back again, probably dropping a load of finished parts by a nearby job on its return. By the time it is needed again for another job, on the locomotive being stripped, it is ready.

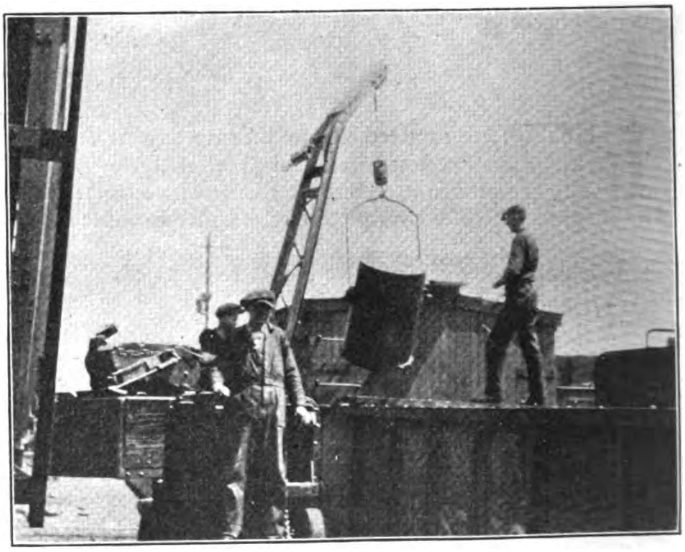
Work done by elevating platform trucks

The elevating platform type of truck with skids supplements the crane type in the work of moving the parts through process. Wooden platforms and metal box skids are used in connection with these trucks which are constantly on the move between the locomotive shops and the other departments. In general the metal boxes are used in the blacksmith shop for taking parts that are still hot directly from the workman or the machine, as the case may be, so that rehandling may be altogether avoided. The wooden platforms are used for all parts up to three tons, a typical load consisting of six or eight locomotive truck springs. It is impossible to detail the jobs done by the storage battery equipment because of the fact that it is used very much as are machine tools. In other words, the



Large castings are carried on the chassis with the aid of the crane

truck is a tool called upon to lift, carry or pull, irrespective of the nature of the job, so long as the total load does not greatly exceed the known capacity of the trucks, a capacity somewhat greater than the two tons in this particular case, which is guaranteed by the maker. Perhaps by citing a few "odd jobs" for which the trucks have indicated fitness through their performance, a somewhat



Chips are carried out and dumped into scrap cars with the crane type trucks

clearer picture of what they are accomplishing may be gained.

Saving on chip removal

Formerly nine wheelers were busy all day long keeping the machine shop clear of chips. The distance that had to be traveled to the siding on which the car was placed that carried away these chips frequently exceeded 1,000 feet and always included a curving up grade of about 6 per cent, 40 feet long. When the crane trucks came into

use the experiment was tried of carrying out the chips in cans, each holding the equivalent of six wheelbarrow loads. On every trip the truck carried four to six of these containers. The net result of this innovation has been a reduction of the labor involved to that of two truckers, each with one helper, working only one hour and 20 minutes a day. The congestion caused by nine wheel barrows constantly moving through the shop has been eliminated. This was particularly gratifying as the aisleways are exceedingly narrow considering the volume of material necessarily constantly on the move. Actually the main runway through the machine shops that are placed at right angles to the locomotive shops, is not over seven feet wide.

Boiler tubes when removed for cleaning and safe ending are placed behind the locomotive on a special flue wagon that runs on standard gage track. When the load is ready, it is run out onto the transfer table and from the table to the flue shop. Formerly 10 men were required for placing the flue wagon on the table and later for pushing it into place in the shop. By the method at present in use, a truck of the elevating platform type

Elevating platform used for unloading wheels from a car

is used to haul the load of tubes. The truck is coupled to the flue wagon and the machine used as a tractor has no difficulty in moving the load. One man can do the job in a shorter time, and entirely without physical effort, that formerly demanded 10 men normally at work on other jobs.

Special spring bumpers have been attached to the front end of the platform trucks to fit them for shoving loads that may be placed from time to time on other wagons or push cars that run in the main aisleways on a standard gage track. Again the trucks are used in spotting cars when a switching engine is not immediately available. Regularly the platform trucks work between the stores department and the various sections of the plant delivering such supplies as may be needed. With equal regularity the crane trucks are used for loading outbound motor trucks carrying heavy stores for shipment to other plants or roundhouses. The complete flexibility of the crane truck is a great advantage in such loading where quarters are tight and overhead cranes are not available.

Building a transportation system

It is clear that in order to keep all of this fleet of 8 units operating efficiently at all times, a transportation organization is desirable. This has been recognized and one man has been given complete charge of the equipment and is entirely responsible for service rendered. The foremen in charge of various sections of the shop are expected to make known to him any special work that is to be done. To speed up movements and to reduce the number of empty runs, a system of flags has been adopted for placing on work waiting to be moved. These are small metal markers, painted yellow with a black letter designating point of destination. The first driver passing such a job without a load is expected to pick it up and move it. The transportation chief is constantly alert throughout the various shops making sure that no jobs are being neglected and dispatching the truck drivers for special work when need arises. Special effort has been made in assigning definite jobs to various truckers to reduce the time to a minimum that they must travel empty.

Another man is constantly at work keeping the trucks in good running condition and preventing truck failures. This man is able to inspect all of the trucks regularly and to make sure that they are properly lubricated.

Although costs of operation are not known definitely at this shop, other data reveals that a charge of $4 a day per truck covers the items of interest, depreciation, maintenance and power in similarly heavy service. Beside saving five times the wage of a hand trucker at a cost of about $4, many worthwhile changes are made possible in shop routine.

The electric industrial truck is seldom thought of as a machine tool, yet performance in this locomotive repair shop justifies the contention on the part of the management that it falls naturally into this class of equipment and that as such it has come to stay.

Cooling and drying compressed air

By J. B. Leonard
American Blower Company, Detroit, Mich.

The problem of eliminating moisture in compressed air is one which has proved a source of worry in many industries throughout the country. Varied have been the remedies which have been applied but in the opinion of the writer, an installation such as the one at the car shops of the Michigan Central, Detroit, Mich., has many distinct advantages, both from the standpoint of effectiveness as well as cost.

These shops were using compressed air in large quantities for operating pneumatic machine tools. This, of course, meant that the air had to be practically free of moisture. In order to solve this problem, it was finally decided to install a system for cooling and drying the compressed air, an elevation and floor plan of which is shown in the sketch. This system is comparatively simple and when once installed, requires little attention. The installation, as shown in the sketch, consists of four No. 40 American Blower pipe coils which are made of standard 1-in. pipe set in cast iron bases of 5 ft. 6 in. and 5 ft. 9 in. length, respectively. Each coil has 160 vertical pipes, arranged with 40 tubes in a row extending the length of the base and four rows wide. The bases are of special construction, having a vertical web along the entire length, dividing the base into two distinct chambers, so that the compressed air will follow different routes and eliminate any possibility of short circuiting.

Referring to the floor plan of the sketch, it will be noted that these coils are used as aftercoolers, designed

to reduce the temperature following the final compression, thus removing a large portion of the moisture content. It was found advisable when operating during the winter months to eliminate all of the moisture possible from the compressed air before it entered the pipe lines, as frost accumulated on the inner surface of these pipes, increasing the pressure drop at the end of the line. In the accumulation of this frost, the walls of the pipe tended to serve as a surface condenser which caused moisture to form on the inside.

A two-stage air compressor, having an intercooler between stages, is used to compress the air to 100 lb. gage pressure. The amount of heat to be removed per hour with a capacity of 1,000 cu. ft. per min. at 100 lb. gage is approximately 600,000 B.t.u. The temperature of the air after leaving the compressor is 225 deg. F., which is reduced to approximately 90 deg. F. after passing the cooling system to the storage tanks.

No use is made of the heat extracted from the compressed air and no provision was made for the mechanical circulation of cooling air around the coils to increase the radiating capacity. One-fourth of the total volume of the compressed air passes through each coil, thus maintaining the velocity within a practical figure. The radiation factor found to exist with this installation was considerably higher than expected, due perhaps to the coils being located outside the building and a comparatively high velocity of air over the coils.

The recommended radiation factor, loss in B.t.u. per sq. ft. per degree drop in temperature per hour, should not exceed three, under the conditions occurring in this installation. In the analysis of a problem such as this, it is advisable to prepare a heat balance between the heat in the compressed air which must be removed and the radiating capacity of the pipe coils sufficient to handle the job. The following formula is used for determining the amount of heat that must be removed from the compressed air per hour:

$$\text{B.t.u.} = \frac{60\, C_1 T}{55}$$

in which
C_1 = the cubic feet of free air entering the compressor per minute.
T = the temperature of the air leaving the last stage, minus the temperature desired at the coils.

The volume of free air entering the compressor may be found by the use of the following adiabatic formula;

$$C_1^{1.41} = \frac{P_2\, C_2^{1.41}}{P_1}$$

in which
C_1 = the number of cu. ft. per min. of free air entering the cylinders.
P_1 = absolute atmospheric pressure.
P_2 = absolute pressure at the last stage.
C_2 = the number of cu. ft. per min. leaving the last stage.

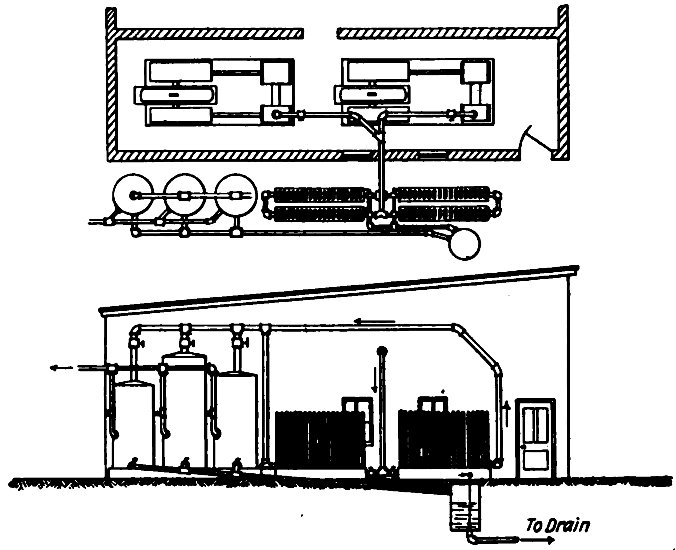
The moisture contained in the compressed air at any point of the system may be found by simply applying the conditions of temperature and pressure existing at that point to the following formula taken from Kent's Mechanical Engineer's Handbook:

$$W = \frac{KH}{2.036\, P - H}$$

W = the weight of water in pounds.
K = the ratio of the weight of 1 cu. ft. of saturated air to 1 cu. ft. of dry air.
H = the elastic tension of water vapor.
P = the absolute pressure in pounds per square inch.

Each of the coils must have two drain pipes to the condensation tank on account of the center web, the valves being left open continuously. The condensation tank is emptied periodically by turning a lever which is located on the floor directly above the drain tank, buried in the ground in front of the right hand coils, as shown in the sketch. The opening of this valve permits the pressure of the air above to force the water out at the drain pipe.

Calculations show that the moisture content of the air, with 100 lb. gage and 90 deg. F., to be approximately 25 grains per pound of air. The success of this installation is apparent when one realizes that the moisture entering the system was approximately 100 grains per pound of air. In a plant of this capacity, about five pounds of water enters the first stage of the compressor per minute. Half of this is eliminated at the intercooler, where the pressure from the first stage is about 30 lb. gage and the temperature is reduced by the cooling water to about 85 deg. F. It is possible with the cooling capacity of this installation to extract an additional 1¼ lb. of water per minute, which necessitates a condensation tank having



Sketch showing the compressed air cooling and drying system in the car shops of the Michigan Central, Detroit, Mich.

a capacity sufficient to contain the moisture drained from the coils for a period of from eight to ten hours.

There are undoubtedly other arrangements which could have been used to as good advantage. However, the choice of any arrangement depends upon the conditions present. The question of utilizing the available heat from the compressed air is a matter dependent upon the continuity of operation, but as the demand for compressed air is somewhat variable, and the compressor is generally controlled automatically, it would appear that to depend upon a continuous source of heat would be taking unwarranted chances.

Should the limitations of space prohibit such an installation as this, it might be advantageous to use smaller coils and provide a fan for the circulation of cooling air, thus obtaining better and more positive results. With a positive circulation, it would also be somewhat easier to predict the results that could be obtained.

THE AVERAGE COST per ton of coal used as fuel for road locomotives in freight and passenger train service for Class I roads in July was $2.68, as compared with $2.98 in July last year, and for the seven months of 1925, including July, the average was $2.77 as compared with $3.15 last year, according to the monthly bulletin of fuel costs compiled by the Interstate Commerce Commission. This covers only fuel charged to operating expenses and does not include switching and terminal companies or fuel for switching locomotives. While the cost of coal shows a reduction the average cost of fuel oil per gallon increased, from 2.89 to 3.33 cents for July and from 2.75 to 3.18 cents for the seven months period. The total cost of coal and fuel oil for July was $25,285,608, as compared with $25,785,903 for July, 1924, and the total for seven months was $188,403,445, as compared with $211,374,783 last year.

Needle valve reseating tool

By Glenn L. Davis

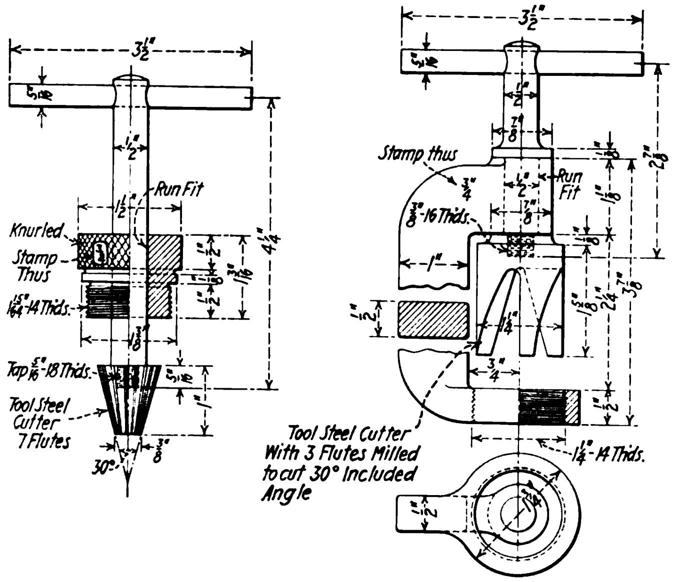
WHERE the locomotive shop toolroom was formerly considered as merely an added overhead burden—a necessary evil—it is now looked to as the originator of time-saving devices and methods and it is worthy of note that, in general, toolroom foremen are measuring up to their new responsibilities and heartily co-operating with tool designers in producing jigs, fixtures and small tools of greater perfection. An example of improvement in railway tool design is shown in the accompanying illustrations.

Needle valves controlling the flow of oil to oil burners of various types, require maintenance of the highest quality to prevent serious leakage losses and leakage dangers. The tool shown in Fig. 1, reseats the valve seat and mills the end of the needle stem to produce an oil-tight joint.

The tool is made in two sizes for ½-in. and ¾-in. needle valves and it is believed, represents a distinct advance over the older method of using a reseating reamer similar to the one shown and, refinishing the needle stem in an engine lathe, or by means of a hollow mill driven in various machine tools. The primary consideration in designing tools of this class is to produce a compact, light, pocket tool so adaptable that it will do away with costly "stripping" to get at the repair job and the more costly replacing of the dismantled piping after the valves are repaired.

Fig. 2 shows the seat reamer removed from the frame. The knurled and threaded nut on the stem of the reamer fits into the threaded bonnet cavity of the valve body when the bonnet is removed and hand pressure on the reamer handle is sufficient for the slight feeding necessary in reaming the average seat. Since the thread on the bonnet of the valve matches the thread on the centering nut of the reamer it is obvious that, with the reamer removed from the tool frame, the valve bonnet, with the valve stem in place in the bonnet, can be screwed into the tool frame in place of the reamer and in this position the stem can be brought up against the hollow mill and refinished.

Fig. 3, which shows the tool completely disassembled, shows how the mill is held against end movement. Since



A tool which reseats the valve seat and mills the end of the needle stem to produce an oil-tight joint

no feeding movement of the milling cutter is possible with this arrangement, it is necessary to feed the valve stem to the work and this is accomplished by screwing the valve stem down through the internally threaded bonnet just as in closing a valve.

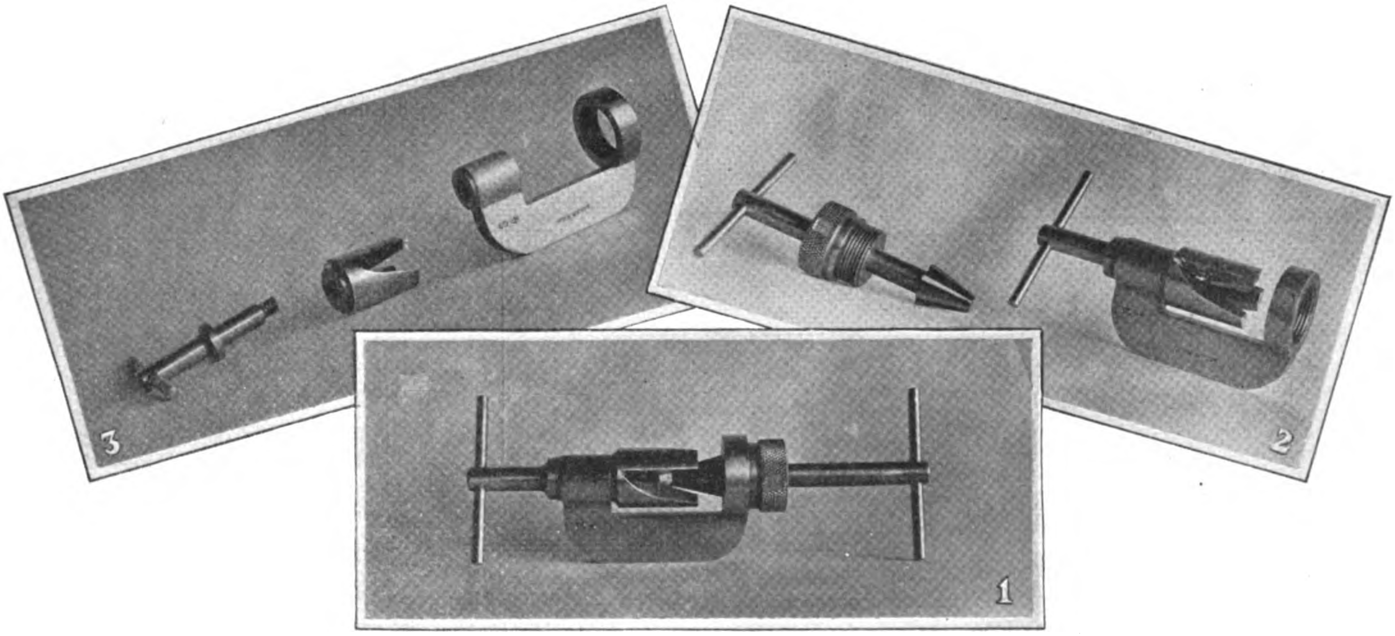


Fig. 1—Reseating tool completely assembled; Fig. 2—Seat reamer removed from the frame; Fig. 3—Tool completely disassembled

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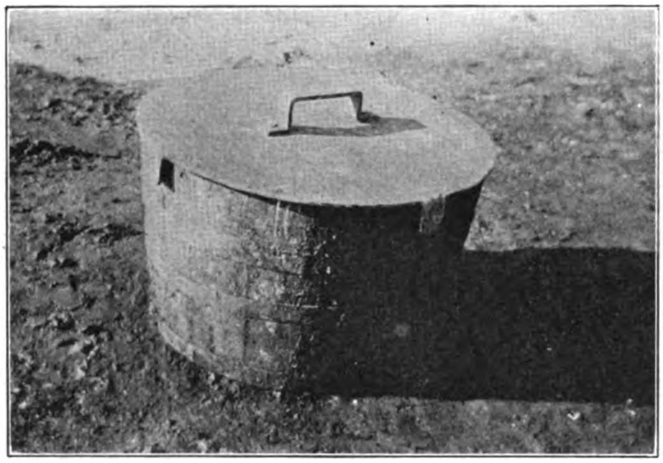
THE PENNSYLVANIA is equipping its dining cars with aluminum chairs, to be made by the Aluminum Company of America, Pittsburgh, Pa. The road aims to eliminate all fire hazards. The chairs will be so upholstered as to harmonize with the decorations. The Pennsylvania at the present time is operating 139 all-steel dining cars, and 10 new cars are under construction.

An inexpensive acid container

By Frank Bentley

A PRACTICAL container for the muriatic acid used to clean scale from injector and other small feed water parts is shown in the illustration. The receptacle is the lower half of a paint or oil barrel, the wood of which being thoroughly oil soaked resists the action of the acid for a long time. The cover of ¼-in. sheet iron is cut with four lugs to keep it securely in place over the top of the container. Together with its weight and ability to shed water, it is a safe and suitable covering. To a convenient depth, the half barrel holds the entire contents of one standard carboy of acid. When eaten out, the renewal of the barrel is a matter of but little time and expense.



Acid container used for cleaning the scale from injectors and other small feed water parts

Driving box calipers for use in limited spaces

By L. V. Mallory

Machine shop foreman, Missouri Pacific, Kansas City, Mo.

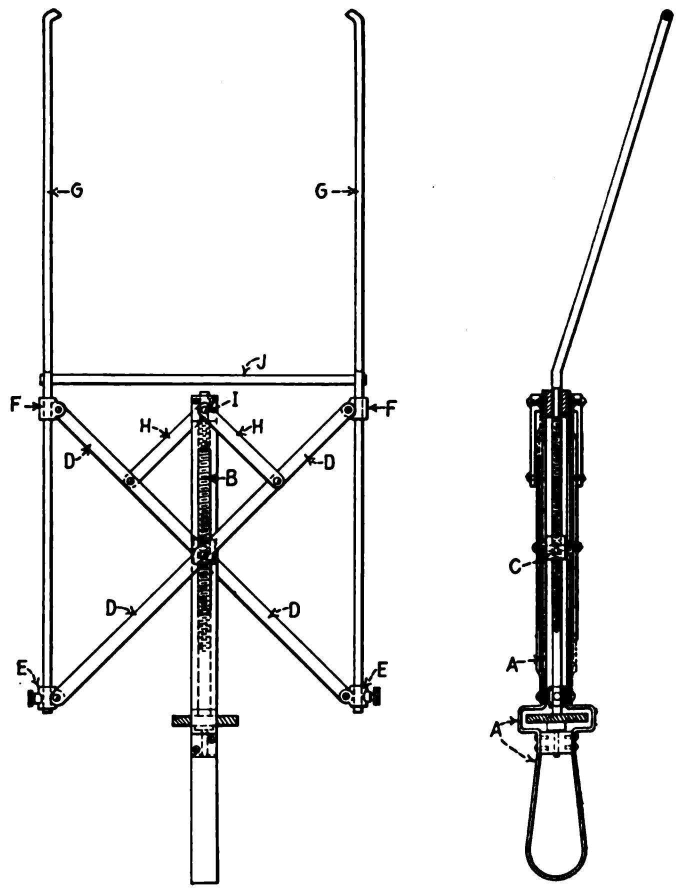
WHERE locomotives equipped with driving boxes of the removable brass type are used, it often becomes necessary to measure the journal diameter and the bore of the crown-brass seat in the box casting when fitting a new brass. This usually must be done without removing the box which leaves a limited space between the journal and the box casting that can not be measured accurately with ordinary calipers. A practical tool for making these measurements is shown in the illustration.

The frame *A*, made of ⅛ in. by ⅝ in. scrap steel, is braced by two small, brass, spacer blocks which also serve as the bearings for the adjusting screw spindles. The adjusting screw *B* is made of ¼ in. round steel which has cut on it standard threads, 20 to the inch. It has mounted on its lower end, a small knurled wheel which is housed in the handle in such a manner that it can be conveniently operated by the thumb. This screw engages the pivot block *C* which is threaded to receive it. The pivot block has a trunnion on each side that extends through slots cut in the frame *A*. Pivoted centrally to these trunnions are the cross-levers *D*, the lower ends of which are hinged to the stationary connecting knuckles *E*, while the upper ends are hinged to the sliding connecting knuckles *F*.

The caliper bars *G* slide through the knuckles *F* with the lower ends rigidly secured in the knuckles *E* by means of knurled, headed thumb screws. These bars are made from 5/16 in. drill rods with the upper ends bent at right angles to form the calipering points. The drawing shows the bars bent, also, just above the sliding knuckles which provides clearance between the axle and the handle and frame.

The upper ends of the two connecting toggle levers *H* are pivoted to the frame while the lower ends are pivoted to the cross-levers *D* at points midway between their upper ends and central pivots.

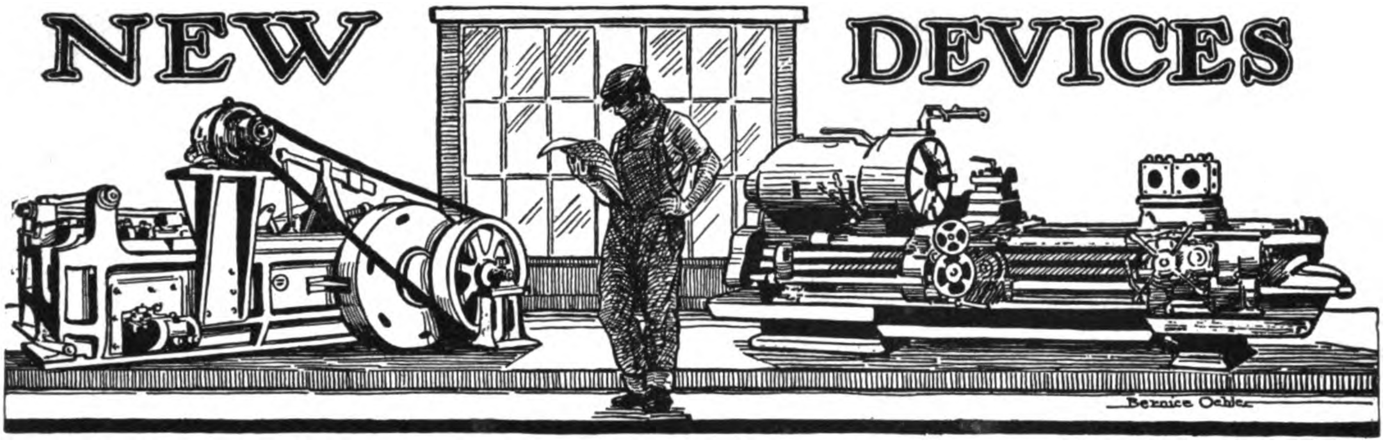
The principle on which the tool works is as follows: The adjusting screw *B* when turned, moves the pivot block *C* vertically between the frame and also moves the levers *D* because the pivot block forms the fulcrum of these levers. Since the connecting toggle levers *H* are hinged to the frame and the free ends connected to the cross-levers *D*, it is obvious that any change in the relative position of the pivot *C* and the fulcrum *I* of the toggle levers will cause them either to close or open the levers *D* according to the direction in which the screw *B* is turned. This action causes the knuckles *E* and *F* to act on the caliper bars G, thus opening or closing them in parallel lines.



Close quarter caliper for use in limited spaces

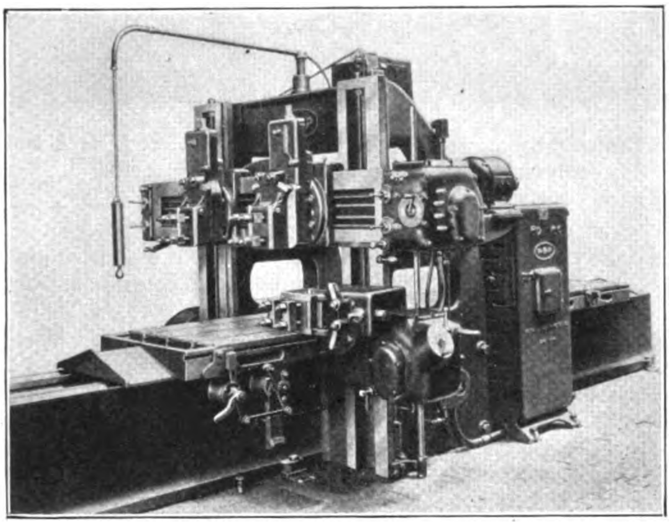
When used for calipering journals, the points face each other. When it is desired to use them as inside calipers for measuring the bore of the seat in the box-casting, the thumb screws attached to *E* are released and the bars *G* are turned half-way round so that the points face away from each other, after which they are firmly secured. A strong, rubber band *J* may be used to take up and lost motion which may occur in the joints.

This tool also can be used to advantage in calipering crank pins and rods when fitting floating bushings.



Planer with unique system of control

A NEW line of planers to be known as the Timesaver model has recently been placed on the market by the Niles-Bement-Pond Company, New York. This model is practically a new design throughout. In developing these machines every effort has been made to meet all modern requirements as to ease and convenience of operation, rapidity of control, safe operation and ample strength and power. An important point bearing on maintenance costs is the decided simplification of construction, many small parts formerly associated with planer design having been eliminated. This new model is furnished in 36-in., 42-in. and 48-in. sizes.



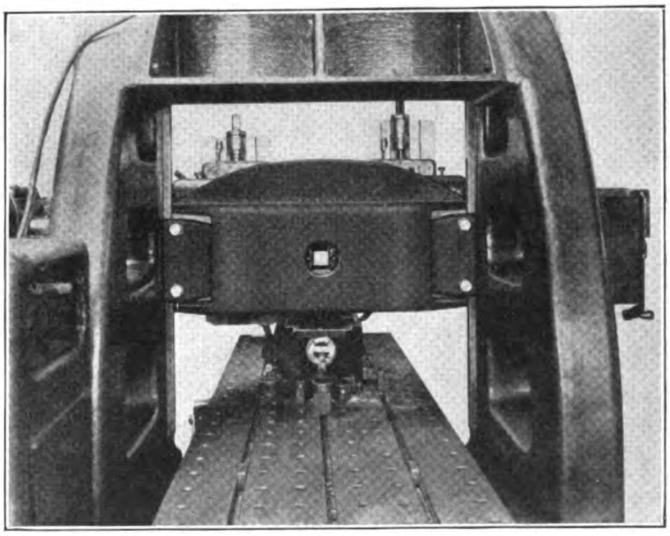
Niles-Bement-Pond Timesaver planer

Among the new and interesting features are electric feed and traverse for both crossrail and side heads; complete control from a pendant switch of all movements of the tool heads, crossrail and table. Another important feature in speeding up work is a duplication of control that gives the workman complete control of all important operations from either side of the machine.

In order to make the planer as easy and convenient as possible to operate and to greatly simplify construction, a motor is mounted at the end of the crossrail to feed the crossrail and side heads, to provide power traverse to all heads and to elevate and lower the crossrail. This motor is controlled by the pendant switch and the table dogs.

The direction of motion for either feed or traverse is determined by four-position levers at the end of the crossrail, one for each crossrail head. The levers are thrown in the direction in which the motion is desired. The feed and traverse motor is controlled by the pendant switch and the amount of traverse can be controlled either by the switch or by the levers. Another lever at the end of the crossrail engages the elevating and lowering of the crossrail.

As there are many times when it is a decided advantage to be able to control the machine from either side, an important feature is the duplication of all control levers. From whichever side of the machine is most convenient the operator has complete control of the traverse and automatic feed of the tool heads, the crossrail clamping and elevating and lowering as well as control of the table motion. The pendant switch can be pulled from one side of the machine to the other. The knob on the pendant switch has four positions, as is shown in one of the illustrations; in the upper or safety position all motion is stopped; in the second position down, the driving motor is controlled for setting the table with the work in the desired position relative to the tools; in the third position down by turning the knob back and forth the traverse of

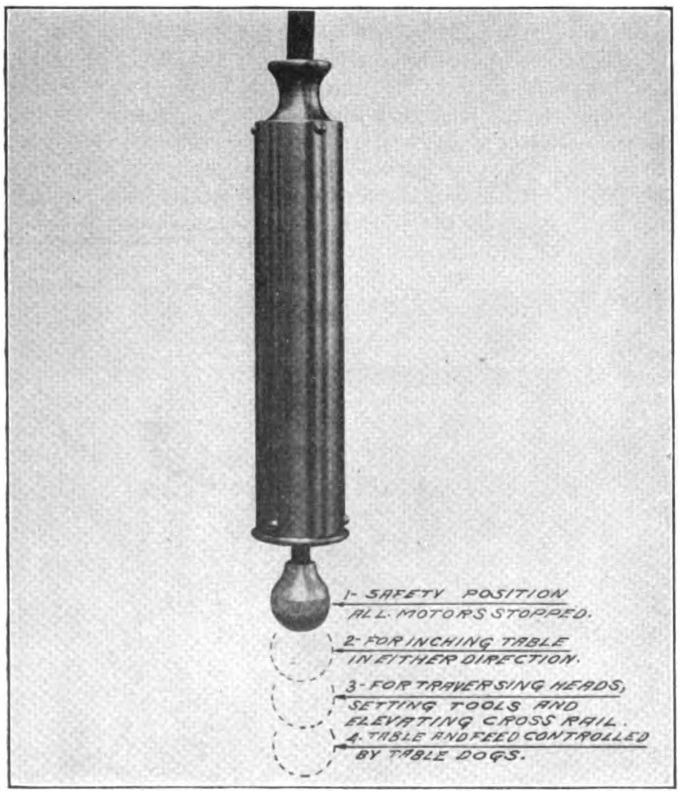


Rear view showing the cross-rail clamping mechanism—A stiffening web on the top of the rail is provided to resist the torsional strains

the heads and tool slides is controlled and tool can be set to the exact required position; in this position the elevating and lowering of the crossrail is also controlled. In the fourth position the table is started and the automatic feed engaged.

Perhaps the greatest step toward simplification on these planers is the electric feed. Ordinarily in the past, on planers of this size, the common practice has been to take the power for feeding the heads from the driving gears in the bed. This has, of course, made it necessary to connect the driving gears in the bed with the feed mechanism at the end of the rail and in the side heads through various gears, shafts and brackets. On the new planers, with electric feed through the motor on the end of the rail a great deal of mechanism has been eliminated. The usual "spring ratchet click boxes" with their troublesome springs and ratchets have been replaced by four-position levers.

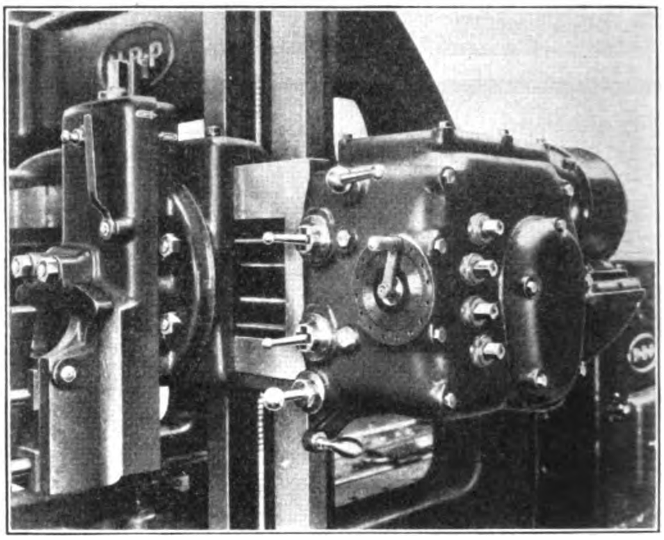
Another advantage of this electric feed is that the maximum feed can be obtained even on the shortest stroke. This results from the fact that with the electric feed the amount of feed possible is not in any way proportional to the length of stroke as is the case with the old type of feed box driven from the driving gears in the bed. By means of a switch the electric feed can be set to take place at either end of the table stroke. The feed is absolutely positive, there being no frictions or springs to get out of order. The selection of the amount of feed



Pendant switch showing the different control positions

is by direct reading dials conveniently located on the crossrail and side head; the side head feed is independent. The minimum feed is 1/16 in. and increases by sixty-fourths to 1 in.

Another time saving feature is the single lever crossrail clamp, so designed as to give an extremely powerful clamping action with an easy effort on the part of the operator. There is a lever at each end of the crossrail so that the crossrail can be clamped from either side of the machine. The operating levers are connected by a shaft running across the rail. A cam keyed to the middle of this shaft bears against a steel plate, as shown in the illustration, which is moved in and out as the operating lever is moved. The steel plate transfers the clamping force to the ends of the clamping levers which have fulcrums at the large bolts shown and bear against the housings thus rigidly clamping the crossrail. The difference between the clamp fit and the sliding fit between the crossrail and the housing is a matter of .0015 in. The clamping effort on the housings is therefore roughly in proportion to the ratio between .0015 in. and the distance



Micrometer collars, compact control levers, electric feed and traverse gear box and motor shown at the end of the cross rail

moved by the hand lever, a ratio which gives a tremendous leverage and therefore an extremely powerful clamping action.

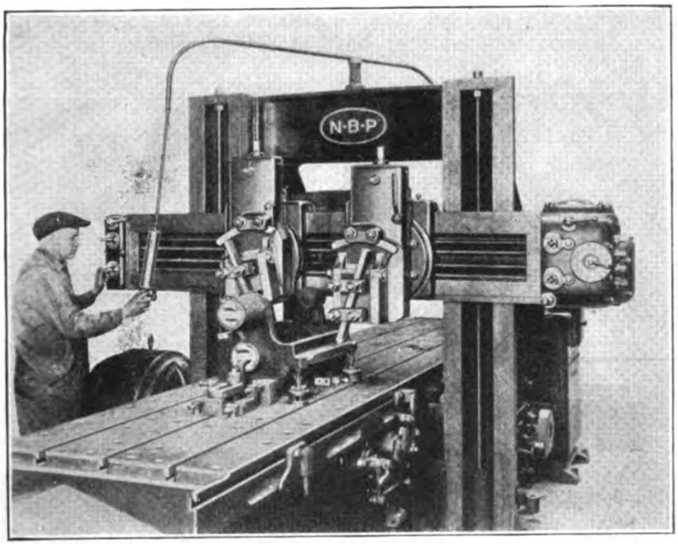
Every effort has been made to make the machine foolproof. The pendant switch is electrically interlocked with the rocker lever at the side of the bed so that when the pendant switch is pushed to the upper position to stop the table the rocker lever is made inoperative so that the table cannot be accidentally started by knocking against the rocker. An electrical interlock also makes it impossible to traverse the heads while the table is in motion and vice versa.

A safety coupling has been provided between the machine and the motor on the rail. This coupling is constructed so as to prevent damage to the machine if the operator traverses or feeds the crossrail heads together, if he traverses or feeds the side heads up against the crossrail, or if he lowers or elevates the crossrail against any obstruction. Again, the clamping levers for the crossrail are interlocked with the elevating levers so that it is impossible to throw in the elevating and lowering lever while the rail is clamped and vice versa.

The side head is designed so that the side head tool may be brought up close to the crossrail tool without any overhang on the crossrail tool slide. In order to do this, the side head is offset; that is, the feeding and traversing driving mechanism are kept below the head. The side head tool has also been brought up in line with the rail head tool. Where this is not done, the table stroke for any job requiring the side head will ordinarily have to be increased a distance equal to the horizontal distance between the tools.

The same gears are used for traversing and feeding the heads and elevating the crossrail and are all contained in

the gear box at the end of the crossrail which is filled with oil. Two large gears driving the small gears on each rod and screw are constructed so that they dip under the oil level and flood the entire box with oil. As an additional precaution, a single shot lubricator has been provided.



Here the operator is shown selecting the direction of motion of the back rail head with his left hand and controlling the amount of motion by turning the pendant switch knob with his right hand

The driving gears in the bed and the table rack are all made of steel and are of the Maag type. They run in oil and in addition, have oil pumped through directly to them. Holes have been drilled down the center of the driving gear shafts with connecting holes to the bronze bushings so that oil is pumped directly to the gear bearings. An oil pump is driven from the driving gears in the bed for furnishing forced lubrication to the table ways. Oil grooves have been planed in the table so that the oil is distributed evenly over the entire bearing surface. A single oil cup has been placed on each side of the heads for lubricating all of the various sliding members.

The gear box at the end of the rail is split so that by removing the bolts in the top cover, it may be removed and all the parts in the gear box are quickly opened for inspection.

The crossrail has been designed to resist the upward bending movement by providing a stiffening web on the top of the rail, and to resist the torsional strains and backward bending movement by making the crossrail deep. This, together with the crossrail gibs on the outside of the housings, and the clamping gibs on the inside, give the crossrail the necessary stiffness. The crossrail heads are offset so as to permit the tools in the heads to be brought as close together as possible.

The tool slides are wide and of full length so as to give the necessary stiffness even while the slide is extended down below the crossrail. The saddle is one solid piece extending around and bearing against the back of the crossrail so as to rigidly resist the cutting pressure at the bottom of the slide.

The bed is twice the length of the table so that the latter never overhangs the bed. Also, no part of the machine is below the floor line.

Boring mill designed for convenient operation

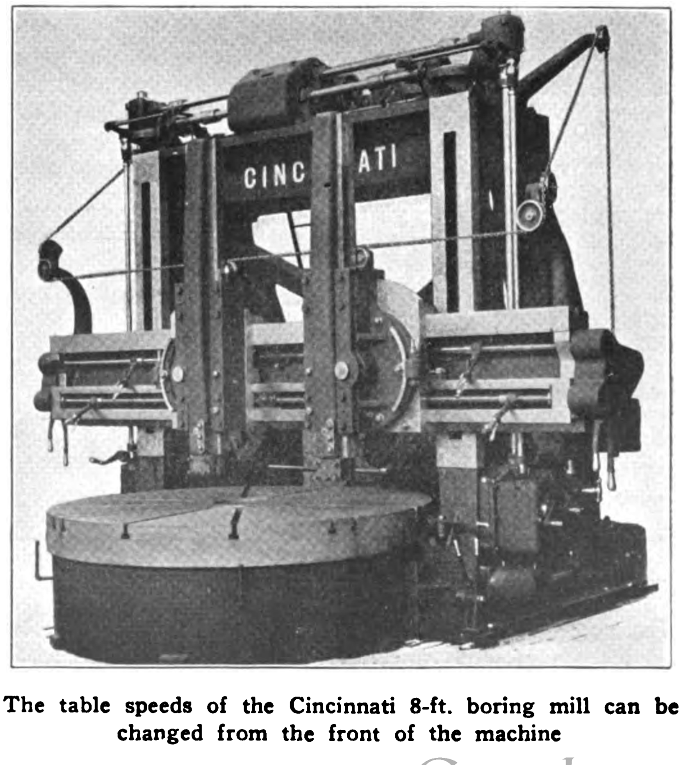
The Cincinnati Planer Company, Cincinnati, Ohio, has placed on the market an 8-ft. boring mill which it is said can be handled as easily and quickly as a mill of much smaller capacity without sacrificing rigidity in any part of the machine. Convenience for the operator, simplicity of design, elimination of wearing parts, and fool-proof arrangements to eliminate all liability of breakage, is shown in the centralized arrangements of all control levers and the operation of the rail lift, rapid power traverse to the heads, centralized oil distributors, etc.

Rapid power traverse to the heads vertically and horizontally is so arranged that by one movement of the operating lever the feeds are disengaged and rapid motion is imparted in the direction indicated by the movement of the lever. When this lever is brought back to a neutral position the rapid power traverse is disengaged and the feed engaged once more. The new design of this mechanism has eliminated all constantly revolving parts with the exception of the motor and one shaft on top of the machine. Safety features are incorporated throughout.

By rapid power traverse the heads are placed at approximately the position desired. Quick adjustment handles are provided for the final setting of the tool. With these the heads can be moved accurately any number of thousandths of an inch without the operator going to the end of the rail. Graduated collars are provided on both feeds for making these final adjustments. Feed changes to both heads are obtained on feed boxes located conveniently for the operator. They have direct reading feeds in inches per revolution of the table.

The rail is elevated and lowered through an instantaneous rail lift mechanism which is positively interlocked with the rapid power traverse and which has an automatic stop for the maximum height of the rail.

On boring mills of this size it has always been custom-



The table speeds of the Cincinnati 8-ft. boring mill can be changed from the front of the machine

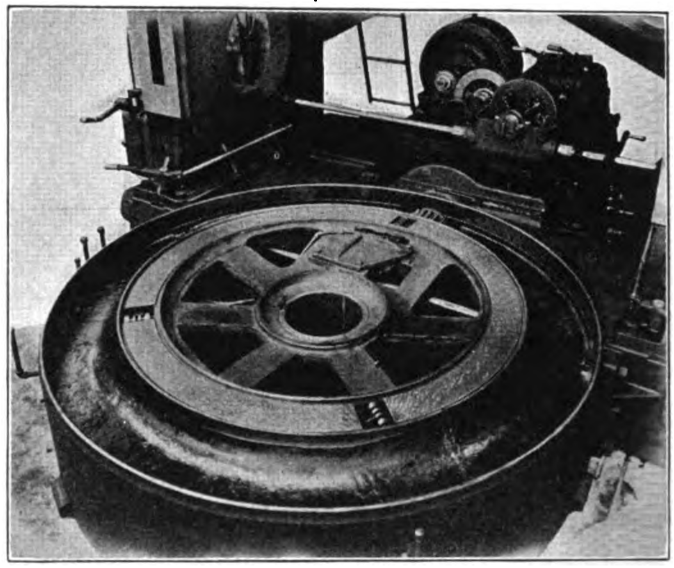
ary for the operator to go to the rear of the machine when changing table speeds through positive gears or clutches. This machine is arranged so that the positive changes in the main gear box are made from the operator's position in front of the machine. To further assist him in setting up work on the table a start and stop lever is used by means of which the table can be revolved any part of a revolution at the will of the operator. This lever operates through a clutch and brake on a high speed shaft in the driving mechanism. When a mill is driven by alternating current motor this feature is of great importance.

The speed gear box is so designed that it acts as a tie between the housing extensions giving additional rigidity to the base of the machine. All driving gears in this box are of steel and all speed changes are through positive clutches. The back gear shaft of this box extends through the front and receives a third bearing in the bed proper. The table pinion shaft also extends from the bed and receives a third bearing in the speed box. All bearings are of bronze and have ample facilities for oiling. All shafts not extending through the box are covered with oil and dirt tight caps.

The design of the bed is a decided departure from the accepted standard. The table bearing has been brought more nearly under the normal position of the load, thus lessening the tendency to spring the table. Heavy radial ribs are used and, as they are shorter are much more rigid. A ground spindle is pressed into the table, running in an adjustable bearing in the bed to compensate for wear.

Heavy housings with wide faces are used, these being mounted securely on large box extensions bolted to the bed and tied together at the back by the speed box. A box type arch ties the housings together at the top. This construction increases the rigidity of the machine when working at any height from the table as it gives sufficient depth to the housings to resist the pressure and bending movement from the tools. The rigidity is also increased by the use of diagonal braces which tie the housings together at the back.

All gears, including those operating the table drive, rapid power traverse and feed, are of steel, the table pinion being of heat treated chrome nickel. All bearings are bronze bushed and have ample facilities for oiling.



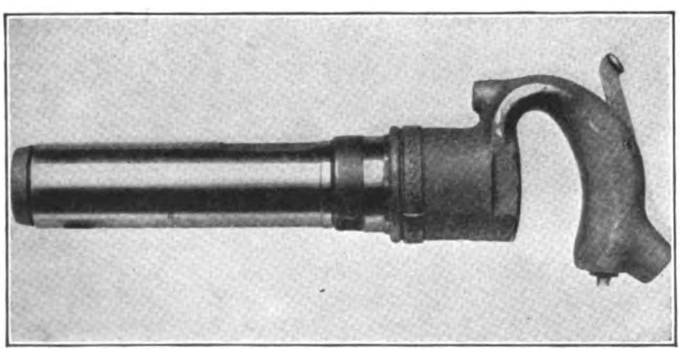
Cincinnati boring mill with the table removed showing the rigid construction of the bed—Note the construction of the gear box at the rear of the table

Oil cups and oilers have been displaced wherever possible by the use of centralized oil distributors which require filling only once in ten days. These distributors are used for all revolving bearings in both feed boxes and all mechanism on top of the rail.

Thor pneumatic riveting hammer

A PNEUMATIC hammer, known as the Thor riveting hammer, and embodying several important improvements, has been developed and placed on the market recently by the Independent Pneumatic Tool Company, Chicago.

The handle of this hammer is drop forged to shape from special alloy steel, particular care having been taken to leave plenty of stock at the bend and at the nipple lug. The handle opening has sufficient room for a large gloved hand and is shaped for a natural grip. The trigger is designed to have correct tension and is located to fit the hand grip. The throttle valve of this hammer is self-feeding, of the balanced type with spiral openings insuring accurate graduation for starting and control. The throttle valve stem, of hardened steel, operates in a bronze bushing. The handle is screwed on the barrel, large V-threads being used and the thread connection is exceptionally long. The handle lock is of the positive ratchet type held by an octagon milled on the barrel. The octagon gives eight positions for each tooth so the teeth always mesh tightly.



New Thor riveting hammer of improved design

The main valve is a hollow substantial sleeve without any portholes. The walls are of even thickness. The inside of the lower end of the valve is ground with a slight taper, eliminating danger of the piston striking the valve squarely. The valve has large and long surfaces, insuring long life, precision of timing and high speed. The exhaust and inlet are widely separated, thus tending to prevent leakage and loss of power. The valve is hardened and ground all over.

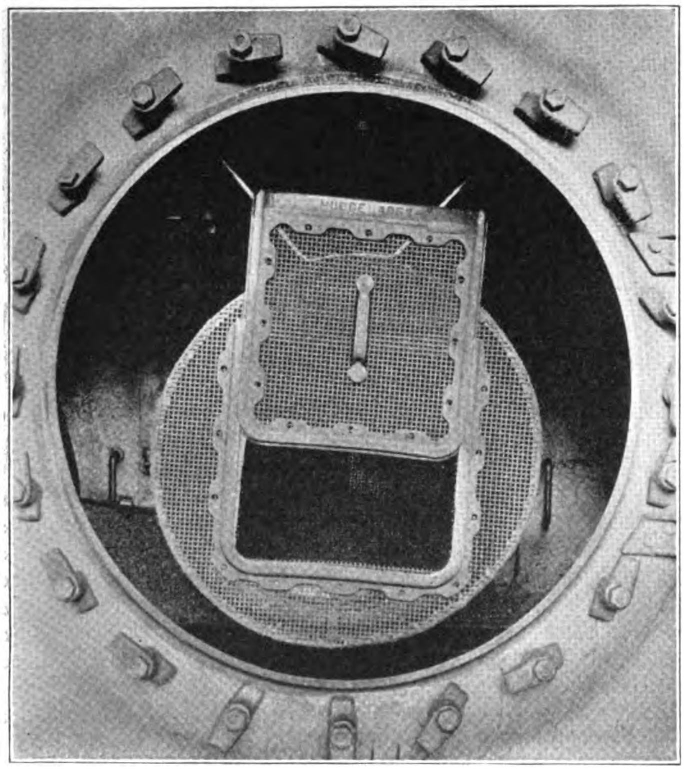
The valve block also is hardened and ground all over, portholes being laid out in straight lines, assuring direct passage of the air in its natural flow and eliminating any effect of wire drawing. The barrel is of alloy steel, heat treated, with the piston bore hardened, ground and lapped. The nozzle bore is hardened and ground. The exhaust at the upper end of the barrel is diverted at any angle which may be desired by the operator by turning a de-

flector. The throttle is designed with a special view to secure it in a certain position so that it will always stay tight while in service.

The hammer is symmetrical in shape, devoid of any projections or irregularities, and carefully balanced like the Thor chipping hammer. It is designed to have accurate regulation, delivering exceptionally rapid and powerful blows with no back kick.

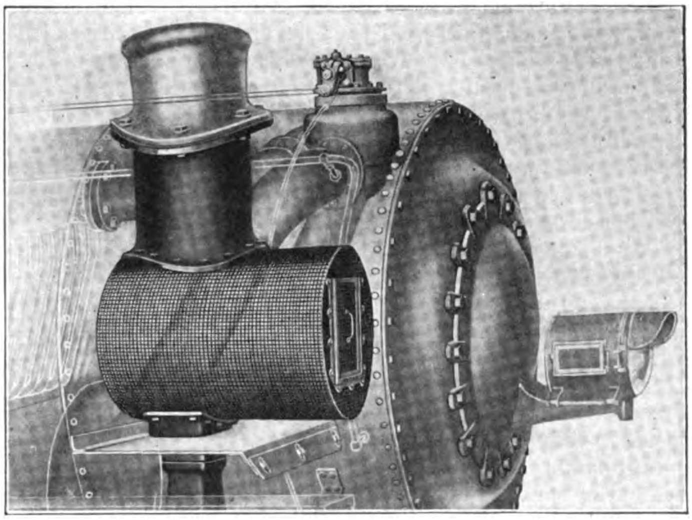
Security unit locomotive spark arrester

A DEVICE designed to prevent the emission of sparks from locomotives and reduce the cost of front-end inspection and maintenance work has been placed on the market recently by Mudge & Company, Chicago. It is called the Mudge security unit locomotive spark arrester. Special features of the design are the increased netting area which permits a larger exhaust nozzle, thereby reducing back pressure, possibility of complete inspection without removal, easy removal and reapplication when necessary, and the elimination of patching joints, always a potential source of trouble in a locomotive front end.



Front view showing spark arrester as applied to one of the three-cylinder locomotives built within recent months

The new spark arrester, shown in the illustration, is built as a unit, welded together and bolted to an angle iron frame apart from the front-end. It is installed through the smokebox front door as a unit without difficulty. The general construction of the spark arrester is evident from the illustration. It is built in the shape of a cylinder small enough to pass through the front-end door. The front and rear ends and seam of the spark arrester are reinforced by suitable angles bolted to the netting. The bottom of the arrester is bolted through a liner to the saddle casting, the top being bolted with a liner to the stack extension.



Phantom view, showing construction and application of Mudge security unit spark arrester

All patching of joints is eliminated in the Mudge curity unit spark arrester as it is entirely independent of any other part of the front-end. There is no interference with superheater or front-end throttle and it permits of complete front-end inspection without removal.

Open-side planer with rigid cross rail

THERE are many classes of work for which the greater convenience of the open-side planer is conceded. But some users of planers have been reluctant to buy machines of this type, fearing that it is impossible to secure the necessary degree of rigidity with the cross rail supported only at one end. In the open-side planer, which the Liberty Machine Tool Company, Hamilton, Ohio, is now building, there are numerous features that commend it to favorable consideration. Among these the question of a high degree of rigidity for the cross rail support has received especial attention with a view to overcoming the possible prejudice of those who would like to use open-side machines for handling jobs that cannot conveniently be set up on a planer with two housings. That this effect has been successful is well attested by the fact that under test on cast iron, with a cut 1½-in. deep and a feed of ¼-in., the maximum deflection at the outer end of the rail was found to be only .0035 in.

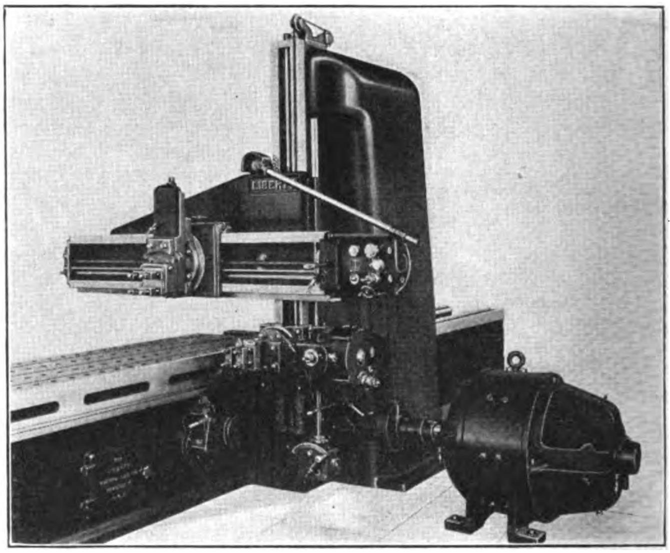
This degree of rigidity is attained through the provision of an unusually massive knee on which the cross rail is mounted. This knee hangs on liberally proportioned bearings on the column and is furnished with an arrangement of gibs for positively locking the knee in any desired position, which is accomplished by a hand crank on a shaft which transmits motion through two pairs of bevel gears

to a vertical screw connected with a taper gib. Turning of the hand wheel pulls this gib up and affords liberal locking power through the combined multiplying action of the screw and the wedge.

On page 122 in the February, 1925, issue of the *Railway Mechanical Engineer,* appears a description of a Liberty planer of the double-housing type. The present open-side planer includes all of the important features which have been incorporated in this machine. One motor is employed for driving the table while independent motors are furnished for the rail and the side head. This arrangement eliminates all overhead work and makes the cross rail and the side head fully independent units, capable of employing any feed or rapid traverse movement.

Elevating or lowering the cross rail and also the power rapid traverse of the rail head vertically and horizontally, are accomplished by manipulating a single lever. With this arrangement it is impossible to engage two different movements simultaneously, thus furnishing a fool-proof control for the rail. Feeding the head vertically and horizontally is controlled by a lever and the desired rate of feed is secured by turning a small hand wheel which is connected with a dial that shows the rate of feed for which the setting has been made. The electric motor, which furnishes these movements, is of 1½-hp. and receives current through a protected trolley that makes contacts with conducting strips fastened to the housing. Either alternating or direct current can be used and, if necessary, it may be taken from a lamp socket. The screws which move the head on the cross rail and the side head on the housing are held stationary and in tension, movement of the heads being accomplished by the rotation of a nut on the screw. A lever is provided for controlling the horizontal feed of the head on the rail or the vertical feed of the tool slide. This vertical movement of the tool slide is also accomplished by revolving a nut around a stationary screw held in tension. Similarly, the screw for elevating and lowering the cross rail is held stationary and in tension. A vertical shaft is employed for transmitting power to the feed mechanism of both the rail head and side head. The transmission gears are so arranged that throwing a lever into two different positions enables the feed to be accomplished either at the end of one cut or just before starting a new cut.

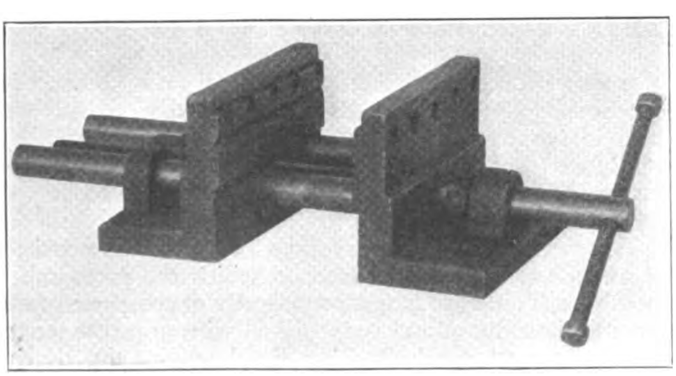
All of the mechanism at the end of the cross rail, that for controlling the feed and power rapid traverse of the side head, and the feed reversing mechanism at the bottom of the housing run in oil. Gages indicate the level of the oil at these points. The housing extends down to the floor and is attached to the bed by means of bolts, fitted into reamed holes. Additional heavy dowel pins eliminate any movement between the housing and the bed. Provision is made for forced feed lubrication, the pump and control valve of this system being located on the outside of the housing. In addition, there is a sight feed attachment which enables the operator to see whether the system is functioning properly. All oil entering the bearings is filtered through a sequence of filtering stations in the bed and then passes through a ½-in. felt wick. The planer bed is twice the length of the table so that the latter never extends beyond the ends. A balanced drive is secured through the use of herringbone gears which eliminate friction and side thrust. These gears are contained in a box cast into the bed to provide for running the gears in a bath of oil.



Liberty open side planer showing compact arrangement of the control levers

A convenient drilling vise

THE D. S. West drilling vise, designed to lighten the work of the machinist, has been placed on the market by the Armstrong Manufacturing Company, Portland, Oregon. The advantages claimed for this vise are its light weight, which is only about one-half that of the ordinary drilling vise; the fact that either jaw forms its own base and may be clamped to the drill press table the other jaw remaining movable, and its ability to hold irregular shapes in almost any conceivable position for drilling.



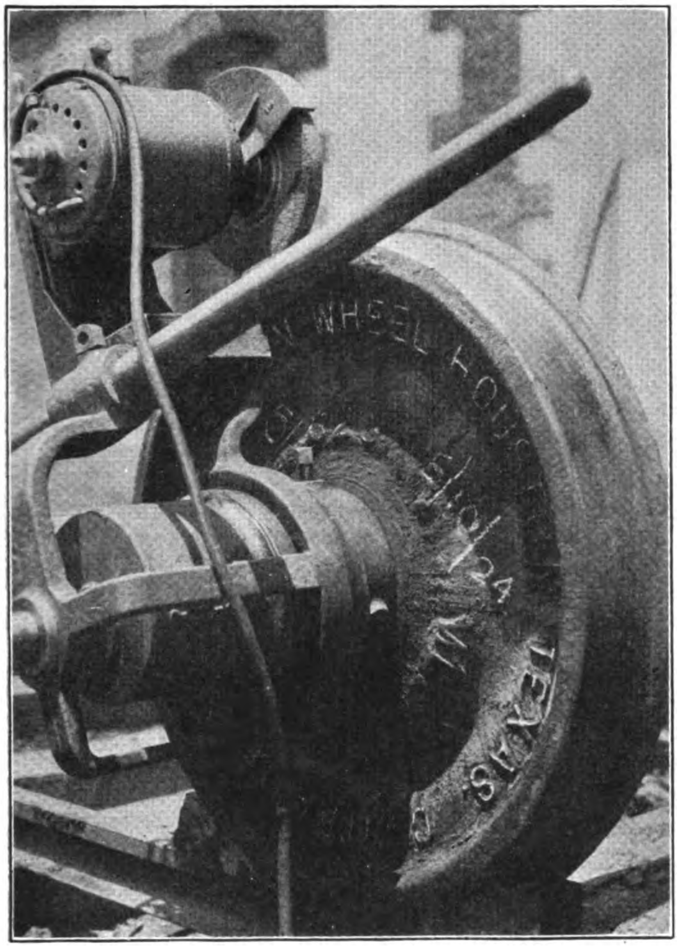
West drilling vise of light weight

The notches machined at the top of the inner edges of the jaws form a rigid support for all kinds of flat and square material, holding such material in a level position so that drilling, tapping or milling may be accomplished. Vertical and horizontal V-grooves are provided for holding round material. Cross rods in combination with the ledges form a base for holding circular, and irregular shapes at any angle for drilling, the cross rods taking the thrust of the drill.

Another feature of the vise is that each jaw is its own base. Either jaw may be clamped down and the unclamped jaw will slide on the drill table. The vise will hold any irregular-shape piece rigidly and will not twist the drill. It is not necessary to block under the work as is the case with many vises.

Castillo portable car wheel grinder

A PORTABLE grinding device has been developed recently for removing the flat spots from car wheels and is being marketed by E. H. Batchelder, Lytton building, Chicago. One of these machines is being used by the Rock Island, one by the Burlington, and five are said to have been in service on the National Railways of Mexico for the past three years reclaiming slid flat wheels with satisfactory results. The machine, which is simple in construction and operation, has the effect of prolonging the life of car wheels. It is driven by a one-horsepower electric motor, weighs about 300 lb., and can be operated by one man. The relatively small weight and cost of this machine, make it especially adaptable to use at rip tracks where the limited number of wheels handled would not justify installing a heavy stationary grinder.

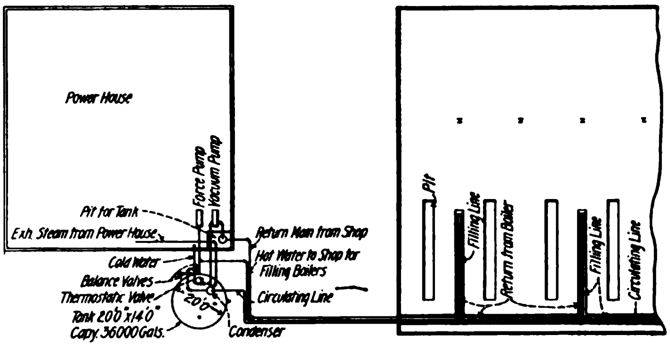

Castillo portable wheel grinder

Referring to the illustration, the construction of the grinder will be evident. The abrasive wheel, driven by special electric motor, is mounted on a cast steel frame capable of a reciprocating, rotary motion about a housing, located centrally with regard to the axle journal and securely fastened to it by set screws. The center of oscillation of the abrasive wheel and steel frame is slightly below the actual center of the axle so that the abrasive wheel moves on an arc larger in radius than that of the car wheel circumference. The effect of the grinder is therefore to spread the flat spot over an arc from 14 in. to 20 in. long depending on the length and depth of the flat spot. The abrasive wheel has lateral movement across the wheel tread by slippage of the cast steel frame on the housing, and radial movement by a feed screw. The tread taper is taken care of by hand adjustment of the feed screw.

Reference to this machine installed on the Rock Island was made at the Mechanical Division proceedings in June, it being stated that 12 pairs of wheels were ground with the machine in 251 min., or an average of 21 min. per wheel, and at a cost of 40 cents per wheel, which did not include the electric current or shop pro rata. The flat spots varied in length between 2½ in. and 3 in. and the metal removed ranged from 3/64 in. to 1/16 in. deep. All of the wheels thus ground were restored to service on the Rock Island equipment and have given satisfactory service since. A careful check of their concentricity indicated that they were not more out of round than is found to be the case with the great majority of new wheels.

Locomotive hot water hydrostatic testing plant

THE accompanying illustration shows a hot water testing plant for back shops or boiler shops where a number of locomotive boilers are tested daily. This work is generally done by filling the boiler with a hot water injector which takes live steam and a good deal of it. One boiler is often tested several times making a large waste of hot water, and as this water runs into a pit it produces a great deal of vapor in the shop. The plant shown has a large receiving and supply tank and a high pressure pump on the discharge line. The discharge line is run below the floor with a connection to each pit. At the far end of the discharge line a circulating line returns to the tank. The pump moves constantly, just enough to keep up the circulation. As soon as the locomotive boiler is connected to the main and the valve is opened, the pump goes to work and will flow any amount required, usually between 300 and 400 gallons per minute so that the boiler is rapidly filled with water at a predetermined temperature. The pump may be so set that it will furnish the required pressure and when it gets to that point it will slow down, or the boiler can be filled and the pressure put on with a hand pump. As soon as the defects have



Piping arrangement of the National automatic, hot water hydrostatic testing plant for locomotives

been chalked the boiler is disconnected from the discharge line and connected to the return line through which the boiler is emptied.

The return line is also below the floor with a connection to each pit. Near the far end it runs through a small regulating tank and from there through a vacuum pump to the main reservoir. The pump is governed by an outfloat on the regulating tank. When a boiler is connected this tank fills up and, through the float, opens the steam line to the pump. When the boiler is empty the pump lowers the water in the regulating tank and shuts off the steam, stopping the pump. The whole arrangement is automatic. A supply of hot water at a fixed temperature is always available. The temperature of the main tank and the height of the water is automatically governed.

This equipment is built by the National Boiler Washing Company, Chicago.

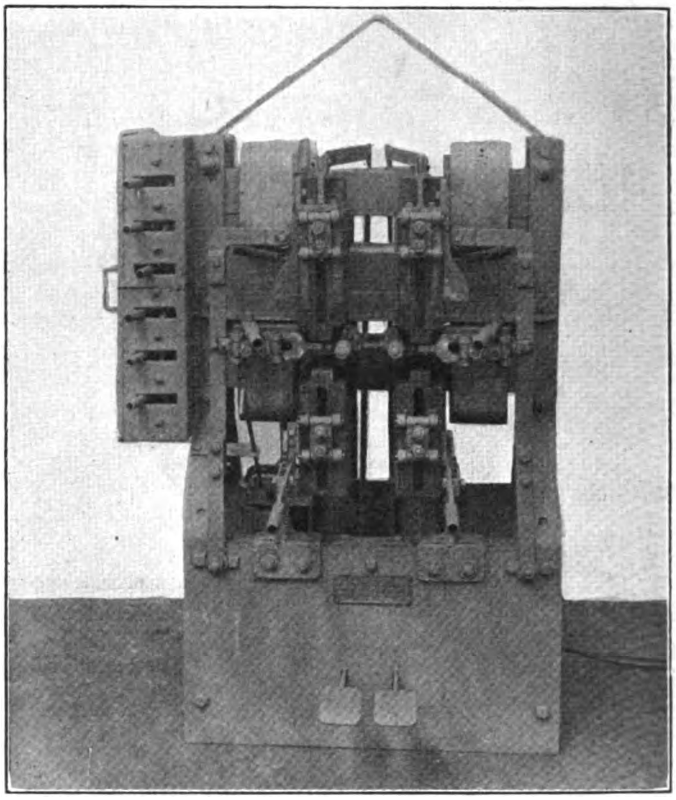
Electric rivet heater for the boiler shop

THREE models of electric rivet heaters, all of which operate on alternating current of any voltage, have been placed on the market by the American Hoist & Derrick Company, St. Paul, Minn. Model A is a two-rivet machine with a 40-ft. super-service table, and weighs approximately 1,100 lb. Model B is a four-rivet stationary type which weighs approximately 1,900 lb. These models are primarily designed for heating rivets for structural work. Model C is a two-rivet machine, especially designed for heating rivets for boiler work. It weighs, ready for service, approximately 2,500 lb.

Model C is equipped with special adjustable side contacts so arranged that the temperature in any part of the rivet may be regulated by the operator. This arrangement enables the operator to heat the grip of the rivet to a white heat, while the end and head are kept at the proper temperature for driving, thus insuring that the rivet completely fills the holes.

The sliding jaws and the E element are of solid cast copper throughout and have thirty times the current carrying capacity of a 1-in. rivet, making it impossible to overheat the machine to a dangerous degree. They are so designed that the rivets up to and including 9 in. in length can be placed in the jaws without any adjustment and with no fear of mushrooming. The sliding jaw permits the E element to be constructed in such a manner as to tightly hug the laminated iron case—its source of power—on three sides, thus practically eliminating magnetic losses and reducing current consumption to a minimum.

All three types are equipped with interlocking heat control, conveniently located at the operator's left hand, which provides instant control of the current. This feature is essential for the proper heating of rivets.



Two-rivet electric rivet heater for the boiler shop

Multiple recording pyrometer

A RECORDING pyrometer which combines accuracy, with other desirable features, has been developed by the Brown Instrument Company, Philadelphia, Pa. The recorder has a die cast black enameled aluminum case. The dimensions are 15 in. high, 14 in. wide and 9 in. deep, requiring a minimum amount of wall space when using a chart 7 in. wide. The instrument is built to make a single record, a duplex record with two records side by side, or in multiple form produces as many as 12 records on one chart.

It operates on the frictionless principle in which a pointer swings freely and at intervals of every 30 sec. is depressed on a carbon or inked ribbon producing a mark on the chart. These marks are so close together as to form a continuous line. The marking ribbon and chart last two months before renewal is required and no inking is necessary. The marking ribbon is above the paper so that the mark is produced on the front side of the paper where it shows clearly. The marking ribbon in the single and duplex recorder, after each mark on the chart, is moved back disclosing the last impression so that the record is clearly visible immediately after it is produced.

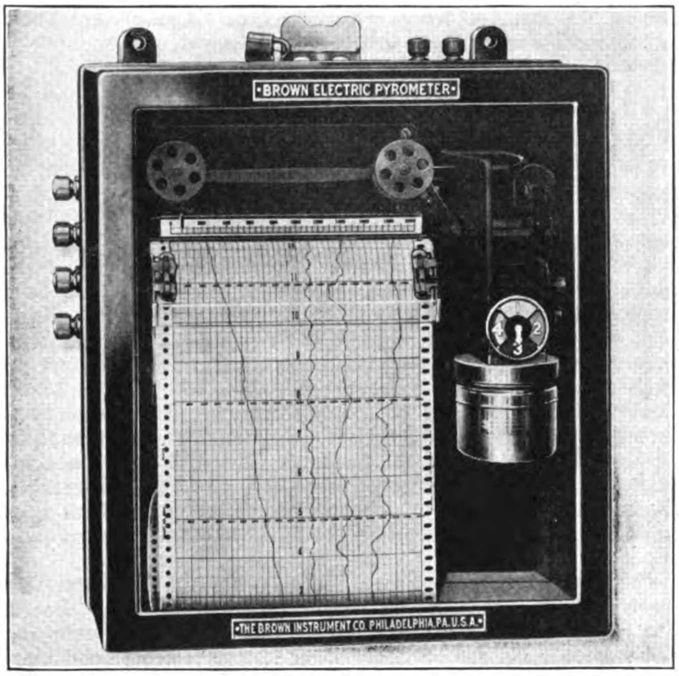
A glass knife edge for tearing off the paper is located directly below the driving roll. The paper can be torn off two hours after the last impression is made.

The galvanometer and the recording chart mechanism is carried on a hinged frame. When swung aside, the galvanometer is instantly accessible, and when closed a housing protects it.

In addition to recording the temperature on the chart, an indicating scale is provided with large figures legible at a considerable distance. The chart has rectangular co-

ordinates. The time lines are straight across the chart and not curved. The recorder is driven by an electric clock if alternating current is available. Six recorders only consume the current required by a 25-watt incandescent lamp. The electric clock eliminates hand winding and no governor or other means is needed to secure accurate timing. Where alternating current is not available, a hand wound clock can be supplied.

The chart speed can readily be changed and is supplied



The chart of the Brown recording pyrometer can be easily read

for a number of combinations. The standard chart speed is one inch an hour but by reversing two gears, a speed of four inches per hour is obtainable. Speed combinations are available from ¼-in. an hour to 6-in. an hour.

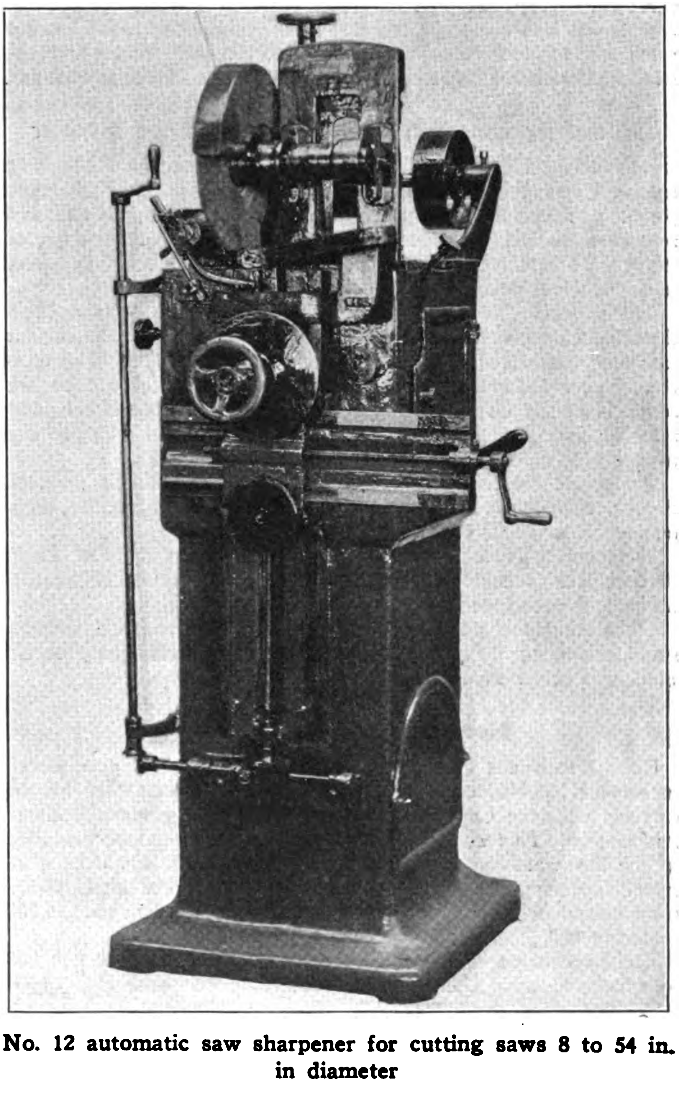
The instrument, as a pyrometer, incorporates an automatic cold junction compensation including the Brown patented index for adjusting a compensated pyrometer to the correct initial starting point on an open circuit.

As a multiple recorder, this instrument incorporates an automatic switch with gold contacts mounted on bakelite and immersed in oil, which prevents any possibility of tarnishing of the contacts from corrosive gases in the atmosphere. The multiple recorder switch includes a dial with an index for indicating the number of the thermocouple or furnace which is being recorded at the time. The record lines are made in different color combinations on the chart and the switch dial is numbered and colored to correspond.

Automatic circular saw sharpener

NOS. 11 and 12 circular saw sharpeners manufactured by the Machinery Company of America, Big Rapids, Mich., embody a type of grinder construction for automatically sharpening, gumming and retoothing medium sized metal cutting saws from 8 to 20 and 8 to 54 in. in diameter. These machines are automatic in their movements and when adjusted to the saw to be retoothed or sharpened may be put in operation and left practically unattended until the work is completed—the saw teeth perfectly sharpened, new teeth cut in if desired, and the saw ready for service. These results are obtained whether the saw is only slightly worn or dulled or is badly damaged. When automatically sharpening the teeth of a dull saw or in grinding in entirely new teeth, these machines will back off the teeth on the same principle as a milling cutter, thereby making a stronger tooth and one that will cut faster than the ordinary V-shape tooth.

The machines are equipped with an index feed so that the feeding and grinding of the saw teeth will not be subject to any unevenness from any uneven, worn or broken condition of the teeth to be ground. With the index feed, perfect sharpening and grinding of the teeth is insured regardless of the condition of the teeth to be ground. Thus, a blank steel plate with no sign of teeth remaining or with broken remnants of teeth will be taken by one of these machines and automatically made into a saw with correct teeth of any desired shape and spacing. This work will be done automatically with no attention from the operator from the time the blank steel plate is placed



No. 12 automatic saw sharpener for cutting saws 8 to 54 in. in diameter

on the machine until it is ready to be taken off as a completed saw, further than an occasional dressing of the grinding wheel or turn of the handwheel to adjust the grinding wheel closer to the work.

The machines are fully automatic throughout, with a heavy solid cabinet frame construction, compact and rigidly supported, with the main working parts (aside from the grinding wheel head and drive pulleys) entirely enclosed in the body, fully protected from all dust, dirt and other foreign matter. The main working parts are provided with ample adjustments for taking up wear and insuring accuracy of action and durable service.

General News

Wage statistics for July

Class I railroads reported to the Interstate Commerce Commission a total of 1.795,669 employees for the month of July, 1925, an increase of 13,973 over the returns for the previous month. The total compensation increased $5,641,770, or 2.4 per cent. The difference in the percentage increase in employment and compensation is due to an increase in the average number of hours worked per employee. Compared with last year, employment shows an increase of 1.3 per cent, while the total compensation increased 3.9 per cent. The percentage difference between the employment and compensation is due to an increase in the number of hours worked per employee coupled with an increase of 5 mills in the average straight time hourly earnings, and 9 mills in the overtime earnings.

Oil-burner runs 3,700 miles with but one layover

Locomotive No. 2517, of the Great Northern, a new oil-burning engine, Class P-2, on Wednesday morning, September 30, completed a round-trip, Seattle, Wash., to St. Paul, Minn., and return—a total distance of 3,571 miles—in less than five days, or 99 hrs. 51 min. Thirteen different enginemen, each way, were successively in charge.

The eastbound train was a special, consisting of 19 cars, 18 of them loaded with silk; and the westbound was No. 27, the regular fast mail, scheduled to run through in 47 hrs. 30 min. The eastbound run, 52 hrs. 25 min., was five hours shorter than the schedule of the Oriental Limited, and on the westbound considerable lost time was made up. With the 19-car train a helper was used for 18 miles ascending the Rocky Mountains.

Eastbound the train left Seattle at 4:30 p. m., Pacific time, on Friday, September 25, and arrived at St. Paul on Sunday, September 27, at 10:55 p. m., Central time.

Westbound, Train 27 left St. Paul on Monday morning about 20 min. late (scheduled to leave at 8:45), and arrived at Seattle, Monday morning on time (6:15 a. m., Pacific time).

Calculating the distance at 3,600 miles, the average rate of speed, including the nine or ten hours in the roundhouse at St. Paul, was better than 32 miles an hour.

New cars and locomotives

Class I railroads during the first eight months this year placed in service 105,446 freight cars, according to reports filed by the carriers with the Car Service Division of the American Railway Association. This was an increase of 490 over the number installed in the corresponding period last year but 10,671 less than were installed during the same period in 1923. Of the total, 11,577 were placed in service in August, including 3,519 box cars, 6,730 coal cars and 269 refrigerator cars.

Freight cars on order on September 1 this year totaled 20,863 as compared with 41,476 on the same date last year and 72,906 in 1923.

Class I railroads during the first eight months in 1925 also placed in service 1,213 steam locomotives, as compared with 1,497 during the same period last year and 2,583 during the corresponding period in 1923. The same roads on September 1, 1925, had 193 locomotives on order, compared with 324 on the same day last year and 1,517 two years ago. During the month of August, this year, 147 locomotives were installed in service. These figures include new, rebuilt and leased equipment.

Strike of enginemen and firemen on the Western Maryland

The enginemen and firemen of the Western Maryland went on strike on October 15, 1925. The movement is said to be participated in by between 400 and 500 men, but it appears that complete passenger train service is being maintained and the officers of the road declare that a considerable percentage of the freight traffic is being moved. Published statements give little information about the real details of the difference between employer and employees, but an increase of five per cent in wages, said to be necessary to make the rates correspond to those which have been adopted by the New York Central Lines, appears to be the main point of dissension. The dispute was taken up by the Railroad Labor Board on its own motion on October 16. On October 21 the Labor Board directed the company and leaders of the brotherhoods to resume the conferences, looking to the termination of the strike, declaring that both sides ought to make concessions. This action of the Board was unanimous.

The officers of the company denied the public statement that the road had disobeyed an order of the Railroad Labor Board. The road has asked the Labor Board to dismiss the case asserting that service is not suffering, passenger service is being maintained 100 per cent and freight service approaching this ratio. This motion has been taken in advisement.

Lackawanna purchases new shop equipment

The Delaware, Lackawanna & Western has purchased the following new machine tools for which the installation has recently been completed in its various shops:

SECAUCUS, N. J., CAR SHOP
- Iron frame standard rip saw and table.

KINGSLAND, N. J., LOCOMOTIVE SHOP
- Tilting reverberatory melting furnace.
- Superheater pneumatic flue welding machine.
- Flue welding furnace for preheating and welding superheater tubes.
- Combination hot saw and tube expander.

SCRANTON, PA., LOCOMOTIVE SHOP
- 90-in. locomotive axle journal turning lathe.
- 86-in. heavy duty face grinder.
- 11-in. by 5-ft. heavy duty lathe.
- 72-in. plain right line radial drill.
- 16-in. by 40-in. by 120-in. piston rod grinder.
- Flat turret lathe.
- Drill grinding machine.
- Universal and tool grinding machine.
- 32-in. heavy duty shaper.
- Universal saw bench.
- 4-in. pipe threading and cutting machine.
- Blacksmith hammer.
- Universal grinding machine.

SCRANTON, PA., ENGINEHOUSE
- Electric arc welder, portable type.

HAMPTON, PA. (SCRANTON, PA.), ENGINEHOUSE
- Single spindle high speed sensitive drill press.

KINGSTON, PA., ENGINEHOUSE
- 50-ton vertical hydraulic forcing, bushing and bending press.

KEYSER VALLEY (SCRANTON, PA.), CAR SHOP
- Single spindle high speed sensitive drill press.
- 2-spindle friezing and shaping machine.

Locomotive repair situation

Date, 1925	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No. req. running repairs	Per cent	Total req. repairs	Per cent
January 1	64,384	53,118	4,849	5,927	9.2	5,339	8.3	11,266	17.5
February 1	64,308	52,994	4,220	6,143	9.6	5,171	8.0	11,314	17.6
March 1	64,255	52,851	4,988	6,217	9.7	5,187	8.0	11,404	17.7
April 1	64,230	52,619	6,241	6,345	9.9	5,266	8.2	11,611	18.1
May 1	64,034	52,933	6,697	6,082	9.5	5,019	7.8	11,101	17.3
June 1	63,976	53,074	6,618	5,916	9.2	4,986	7.8	10,902	17.0
July 1	63,942	53,025	6,600	5,832	9.1	5,085	8.0	10,917	17.1
August 1	63,921	53,263	6,313	5,740	9.0	4,918	7.7	10,658	16.7
September 1	63,812	53,261	5,902	5,514	8.6	5,037	7.9	10,551	16.5

Data from Car Service Division reports.

48-in. by 21-in. compression type pneumatic yoke riveter.
4-in. heading, upsetting and forging machine.
Blue-printing machine.
Power brake.
Power shear.
Car type annealing furnace.

East Buffalo, N. Y., Locomotive Shops
60-in. by 60-in. by 12-ft. metal planer.
2¼-in. by 24-in. flat turret lathe.
84-in. heavy vertical boring and turning mill.
62-in. horizontal boring and drilling machine.
36-in. heavy duty, new type railroad draw-cut shaper.
11-in. by 5-ft. heavy duty lathe.

Gravel Place, Pa., Enginehouse
12½-ton locomotive crane.

All of these machine tools are motor driven and are provided with push button control.

The 90-in. journal turning and quartering machine installed in the locomotive shops at Scranton is equipped with a counterbalancing device which permits the counterbalancing of wheels in the lathe with little effort and insures accuracy in the turning of journals. This machine is also equipped to turn journals on main crank axles for three-cylinder locomotives and for quartering driving wheels for both two and three-cylinder locomotives. It is estimated that a machine of this type will handle the work of a locomotive shop which has an output of approximately 30 locomotives a month and keep up with the production of the other departments. The 36-in. draw-cut shaper installed in the erecting shop at East Buffalo is a heavy production machine and was secured for machining the back and front end main rod brasses, planing shoes and wedges after being laid out and for slotting and planing cast steel driving boxes. It is expected that this machine, which has been assigned to this special work, will secure increased production due to its high power and adaptability for this particular class of work.

Locomotives installed and retired

Month—1925	Installed during month	Aggregate tractive effort	Retired during month	Aggregate tractive effort	Owned at end of month	Aggregate tractive effort
January	167	7,455,971	213	6,242,079	64,824	2,590,525,478
February	125	6,233,494	169	5,118,878	64,779	2,591,618,849
March	138	6,249,721	170	4,888,933	64,747	2,592,979,637
April	171	7,498,252	409	13,126,135	64,509	2,587,347,354
May	147	7,930,840	172	5,329,461	64,484	2,589,912,779
June	179	9,746,100	224	8,296,659	64,435	2,591,286,720
July	139	7,208,534	170	5,602,619	64,420	2,593,971,635
August	147	8,384,262	210	5,866,368	64,357	2,596,489,549
Total for 8 months	1,213	....	...	....	......	....

Figures as to installations and retirements prepared by Car Service Division, A. R. A., published in Form C. S. 56A-1. Figures cover only those roads reporting to the Car Service Division. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

Freight cars installed and retired

	Installed during month	Aggregate capacity tons	Retired during month	Aggregate capacity tons	Owned at end of month	Aggregate capacity tons
January, 1925	11,768	551,263	7,867	326,812	2,341,109	103,812,974
February	15,024	721,867	9,453	365,111	2,346,687	104,169,525
March	16,007	753,947	12,067	474,644	2,350,697	104,454,128
April	13,749	652,462	10,497	423,322	2,353,956	104,683,798
May	12,982	612,607	8,658	335,401	2,356,641	104,902,235
June	12,191	590,657	9,797	365,589	2,359,040	105,127,861
July	10,542	504,185	10,051	384,084	2,361,551	105,350,472
August	11,554	564,681	9,259	364,487	2,363,849	105,550,765
Total for 8 months	103,817	.....	.....	......	....	....

Figures as to installations and retirements prepared by Car Service Division A. R. A. Figures cover only those roads reporting to the Car Service Division. Figures of installations and retirements alike include equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

Meetings and Conventions

Tentative program announced for the annual meeting of the A. S. M. E.

A tentative program has been arranged for the annual meeting of the American Society of Mechanical Engineers which is to be held at the Engineering Societies building, 29 West Thirty-ninth street, New York, November 30 to December 4, 1925. The sessions begin at 9:30 a. m. on Monday, November 30, with a meeting of the council followed by a conference of the delegates from the local sections. At 2 p. m. the council and local sections delegates reconvene, and there is also scheduled a meeting of the main Committee on Power Test Codes. An open house for all in attendance at the convention is scheduled for that evening.

The program contains a number of subjects which will be of special interest to railway mechanical department officers. The Railroad Division meets on Tuesday, December 1, at 2 p. m., at which time there will be papers presented on locomotive boilers and on car design, the authors of which are yet to be announced. Sessions of interest to mechanical engineers engaged in railroad work are given in the tentative program as follows:

Tuesday, December 1

9:30 a. m.—Oil and Gas Power Division
Machine Shop Practice Division (I)
2:00 p. m.—Railroad Division
4:30 p. m.—Henry Robinson Towne lecture on engineering and economics, by the Hon. Herbert Hoover
Evening—Award of honorary memberships to the Hon. Herbert Hoover and Worcester R. Warner, past president, A. S. M. E.
Presidential address and reception

Wednesday, December 2

9:30 a. m.—Industrial Furnaces (Fuels Division)
Materials Handling Division
Machine Shop Practice Division (II)
Springs (Special Research Committee on Metal Springs)
Luncheon of council and student branch delegates
2:00 p. m.—General
Annual report of council
Award of Charles T. Main, junior and student prizes
Report of A. S. M. E. investigation for S. P. E. E. on mechanical engineering education
Progress reports of A. S. M. E. professional division
Education and training for the industries of non-college type (Committee on Education and Training for the Industries)
Steam tables research
Student branch conference
Ladies tea and reception
Evening—Annual dinner at Hotel Astor

Thursday, December 3

9:30 a. m.—Steam power (Power Division)
Management Division
Aeronautic Division
2:00 p. m.—Power Plant Materials (Power Division)
Industrial Psychology
Lubrication (Special Research Committee on Lubrication)
Robert Henry Thurston lecture on engineering and science, by Dr. Zay Jeffries
Evening—National Defense Division

Friday, December 4

Council and committee meetings
Excursions

Power and mechanical engineering exposition

The fourth national exposition of Power & Mechanical Engineering will open at 2 p. m. on Monday, November 30, at the Grand Central Palace, New York City, and will extend through the week ending December 5. The basic purpose of the exposition is to bring together showings of manufacturers of power and mechanical equipment so that engineers and industrial executives may have an opportunity for comparative study of the outstanding developments in the field. Devices to increase the effectiveness and economy of combustion and machine tools and equipment used in machine shop practice will be main features of the exhibit.

Freight car repair situation

1925	Number freight cars on line	Cars awaiting repairs: Heavy	Light	Total	Per cent of cars awaiting repairs
January 1	2,293,487	143,962	47,017	190,979	8.3
February 1	2,305,520	139,056	47,483	186,539	8.1
March 1	2,313,092	141,192	43,855	185,047	8.0
April 1	2,315,732	143,329	43,088	186,417	8.1
May 1	2,316,561	144,047	45,467	189,514	8.2
June 1	2,320,261	146,998	48,988	195,986	8.4
July 1	2,326,734	150,530	47,938	198,468	8.5
August 1	2,335,223	153,674	43,607	197,281	8.4
September 1	2,333,849	149,705	47,473	197,178	8.4

1925	Cars repaired: Heavy	Light	Total
January	69,084	1,358,308	1,427,392
February	66,283	1,313,088	1,379,371
March	71,072	1,348,078	1,419,150
April	69,631	1,290,943	1,360,574
May	65,651	1,276,826	1,342,477
June	71,789	1,296,558	1,368,347
July	70,087	1,330,595	1,401,682
August	71,307	1,369,878	1,441,185

Data from Car Service Division Reports.

June Mechanical convention

After a joint meeting of the General Committee of Division V—Mechanical, American Railway Association, and the executive committee of the Railway Supply Manufacturers' Association, held in Philadelphia, October 13, it was decided to hold the annual convention of Division V and the R. S. M. A. exhibit on Young's Million Dollar Pier at Atlantic City, N. J., June 9-16, inclusive. In all probability Division VI—Purchases and Stores, A. R. A., will hold its annual convention at Atlantic City at the same time.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association, Division V.—Mechanical—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 9-16, inclusive, Young's Million Dollar Pier, Atlantic City, N. J.

Division V.—Equipment Painting Section.—V. R. Hawthorne, Chicago.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet Ave., Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Steubing, Bradford Corp., 25 West Forty-third St., New York.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Canadian Railway Club.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting, November 10. Paper on Analysis of Shop Output and Costs will be presented by J. W. Kennedy, general supervisor production department, Canadian Pacific, Montreal.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Car Foremen's Club of Los Angeles.—J. W. Krause, 514 East Eighth St. Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, Hotel Statler, Buffalo, N. Y. Next meeting, November 12. Paper on main tracking of freight trains will be presented by D. W. Dinan, assistant general manager of the New York Central, Syracuse, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November. Next meeting November 18. Paper on General Railroad conditions will be read by C. A. Radford, publicity agent, Big Four Route. Annual meeting, election of officers and turkey dinner.

Cleveland Steam Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Cleveland, Public Square, Cleveland.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. B. Hutchison, 1809 Capitol Ave., Omaha, Neb. Next meeting May 11-14, 1926, Hotel Sherman, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York. Next Meeting May 25-28, 1926, Hotel Statler, Buffalo, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting November 10. Paper on Activities of the American Railway Engineering Association will be presented by J. E. Armstrong, assistant engineer, Canadian National.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday each month, except June, July and August, at 29 West Thirty-ninth St., New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 625 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately. Next meeting November 12 at Hotel Oakland, Oakland. Associate members night. Papers on the relation of the supply industry to the roads, selling the railroads and the service of the service engineer will be presented.

Railway Club of Greenville.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

Southeastern Carmen's Interchange Association.—J. E. Rubley, Southern Railway shops, Atlanta, Ga.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

Western Railway Club.—Bruce V. Crandall, 226 W. Jackson Blvd., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

The Southern Wheel Company, Pittsburgh, Pa., is contemplating the construction of a plant in St. Louis, Mo.

V. B. Emrick has been appointed a representative of the Locomotive Stoker Company, with headquarters at Chicago.

The Harnischfeger Corporation, Milwaukee, Wis., plans the construction of an addition to its plant at 38th street and National avenue.

J. P. Carney, for the past 13 years general car inspector of the Michigan Central, with headquarters at Detroit, Mich., has joined the sales force of the Grip Nut Company.

C. W. Owsley has been appointed district manager, railway department, at New York, of the E. I. du Pont de Nemours & Co., Inc., in the paint and varnish division, specializing in the Duco products.

The General American Tank Car Corporation, Chicago, has established southern sales offices in New Orleans, La., at 1022 Union Indemnity building, in charge of Z. R. Simon, southern sales manager.

A. A. Helwig, superintendent car department of the Kansas City Terminal, has joined the sales organization of the Bradford Corporation, New York. Mr. Helwig will have his headquarters at St. Louis, Mo.

Joseph T. Ryerson & Son, Chicago, has acquired full rights covering the manufacture and sale of the horizontal drilling and boring machines heretofore manufactured and sold by the Harnischfeger Corporation, Milwaukee, Wis.

The Boss Bolt & Nut Works Division of the Hoopes & Townsend Corporation, Philadelphia, Pa., has been organized through the consolidation of the American Bolt Corporation, New York, and the Hoopes & Townsend Company, Philadelphia.

The Standard Steel Car Company has awarded a general contract to the Austin Company, Cleveland, Ohio, for a one-story addition, 80 ft. by 335 ft., and improvements to its present shop at Hammond, Ind., to cost approximately $200,000 with equipment.

G. R. Ingersoll, of the Associated Materials Company, with officers at 935 Schofield building, Cleveland, Ohio, has been appointed representative of the Morton Manufacturing Company, Chicago, to handle the sale of this company's products throughout the Cleveland district.

E. Thomann, managing director of the railroad department of Brown, Boveri & Co., Ltd., of Baden, Switzerland, and A. Buchli, executive director of the Swiss Locomotive Works, at Winterthur, affiliated with the former company, have arrived in this country to inspect various systems of railroad electrification in operation here. The Brown Boveri Company expects soon to enter actively into the manufacture in America of electrical equipment, including electric locomotives, through an American company now in process of organization.

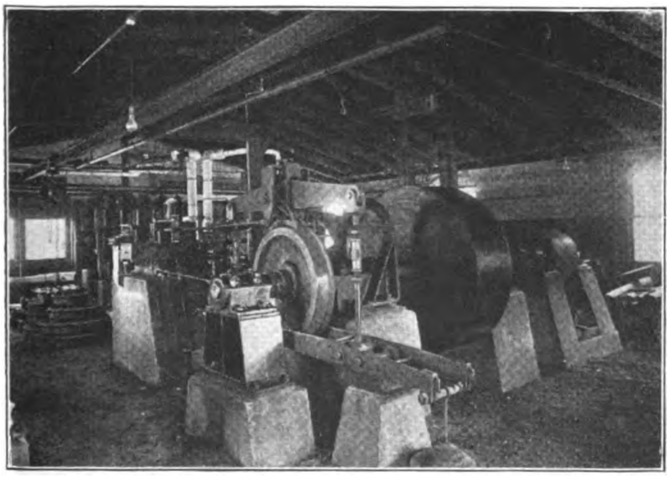
The Air Preheater Corporation, 25 Broadway, New York, manufacturers of the Ljungstrom Air Preheater, is a consolidation of James Howden & Co. of America, Inc., and the Ljungstrom interests of Stockholm, Sweden. The newly formed corporation takes over all Ljungstrom patent rights of the preheater, together with the shops of James Howden & Co. of America, Inc., at Wellsville, N. Y. B. G. Brolinson has been elected president of the Air Preheater Corporation. W. L. Batt, president of S K F Industries, is chairman of the board of directors.

J. H. Williams & Co., Buffalo, N. Y., has just introduced a new line of wrenches made from chrome-molybdenum steel. These tools, known as the Superrench, will supplement the Superior drop forged wrenches of carbon steel, the chrome-molybdenum steel providing a stronger and tougher material with a decrease in weight impossible of attainment with carbon steel. These tools are available in four styles, all heat treated: Engineers' pattern, double head, 15 deg. angle openings—a wrench with thinner and narrower jaws and of generous length; general

service "S" pattern, long and light with unusual leverage; construction pattern, single head, 15 deg. angle opening; structural pattern, single head, straight opening, offset handle.

At a recent meeting of the board of directors of the Westinghouse Electric & Manufacturing Company, Richard B. Mellon, of Pittsburgh, Pa., was elected a director, to fill the vacancy caused by the death of William McConway. Edward D. Kilburn and Walter S. Rugg were recently elected vice-presidents of the company; Mr. Kilburn and Mr. Rugg have been connected with the Westinghouse company for many years. Vice-president W. S. Rugg will take over the direction of Westinghouse engineering activities and vice-president and general sales manager E. D. Kilburn will direct the sales activities as arranged by F. A. Merrick, vice-president and general manager. Mr. Kilburn retains his office of vice-president of the Westinghouse Electric International Company. H. D. Shute, vice-president, will retain his direction of the commercial activities of the company including especially customer relationships, and H. P. Davis, vice-president, formerly in charge of engineering and manufacturing activities as applying to the strictly electrical portions of the company's business, will in future have direction over the entire manufacturing activities of the company and of the general features of the radio business including broadcasting. The duties of the other vice-presidents of the company remain unchanged.

The American Foreign Sales Corporation, a recent incorporation with office at 150 Broadway, New York City, has elected W. G. Kaylor president, and G. A. Smith secretary and treasurer. The directors include the two officers above and F. A. Schaff, vice-president of the Superheater Company; C. S. Sale, executive department, American Car & Foundry Company; Rodney Hitt, of Hitt, Farwell & Company, and Samuel A. Pleasants, of Marvin & Pleasants. The company was organized to promote the sale in foreign markets of American products and is well equipped to handle sales in foreign countries of American railway supplies and equipment. W. G. Kaylor was formerly manager for the Orient for the Westinghouse Air Brake Company and associated companies. Mr. Kaylor was born on April 18, 1883, at Indianapolis, Ind., and graduated as a mechanical engineer from Purdue university in the class of 1905. In 1908 he received a masters degree in mechanical engineering from the same university. Shortly after graduation he entered the service of the Westinghouse Air Brake Company as a special apprentice at Wilmerding, Pa. He subsequently was engaged in installing air brakes on the New York Central's all-steel passenger cars. In 1907 he was instructor of motormen and engineers in the operation of electrified cars and locomotives on the New York Central and the New York, New Haven & Hartford operating out of New York City. In 1911 he was engaged in commercial engineering work for the Westinghouse Air Brake Company at New York. He also had charge of the company's export department and for about a year represented the company in South America. Subsequently he represented the Air Brake Company and associated companies as manager for the Orient, with office in Tokio, Japan, and served in that capacity until November, 1924.



Brake shoe testing machine in the railway engineering laboratories at the University of Illinois

Trade Publications

Reliance motors.—Ball and roller bearing reliance motors for direct and alternating current are described and illustrated in Bulletin No. 4000 issued by the Reliance Electric & Engineering Company, Cleveland, Ohio.

Leather belting.—A non-technical summary of research on the applications of leather belting as compiled by the Leather Belting Exchange Foundation, Cornell University, has been issued in booklet form by the Chas. A. Schieren Company, New York.

Steel filler rods.—The properties of iron or steel filler rods for both gas and metallic arc welding are described in a 28-page booklet issued by the Chicago Steel & Wire Company, Chicago, Ill. Many questions which have hitherto perplexed those interested in fusion welding are answered in this booklet.

Chucks.—The Union Manufacturing Company, New Britain, Conn., has issued a 64-page illustrated catalogue descriptive of its line of chucks, which includes combination, universal independent, geared scroll, scroll combination, planer, boring mill, car wheel, grinding machine, box body, round body and drill chucks.

Milling cutters.—The Goddard & Goddard Company, Detroit, Mich., has recently brought out a catalogue on milling cutters and their uses, which is devoted exclusively to milling cutters adaptable for use in railroad shop work. Complete descriptions and specifications of the various types of cutters, as well as information pertaining to the particular class of work for which they are designed, is contained in this 96-page catalogue.

Electro-mechanical hammer.—The Kango electro-mechanical hammer, which is of a light chipping, caulking and scaling type, for use on metal, stone, wood or other material, is described and illustrated in a 12-page brochure issued by the Kango Company, Ltd., London, England. This hammer consists of a cylindrical casing fitted at the upper end with a stirrup-shaped handle, through which is led the cable for the motor and in which is situated the trigger switch.

Electric rivet heaters.—American electric rivet heaters and shop appliances are described and illustrated in a 16-page booklet issued by the American Hoist & Derrick Company, St. Paul, Minn. A seven-day comparison of the results obtained with an American electric rivet heater and an ordinary oil furnace appears in the booklet in tabular form, the sizes, numbers of rivets and weights being given, also the current consumption for the electric heater and the oil consumption for the oil heater.

Agathon alloy steels.—The Central Steel Company, Massillon, Ohio, has gotten up a handy disk of celluloid construction for the use of those who are engaged in the heat treatment of alloy steels. By turning the slide on one side of the disk to the grade number, the composition of that particular grade is obtained and also a reference letter referring to the proper treatment is given. By turning the slide on the opposite side of the disk to the reference letter, data as to the proper heat treatment can be obtained.

The four-wheel trailer truck.—Under the title of "The Locomotive Four-Wheel Articulated Back End," the American Arch Company, Inc., New York, has issued an eight-page pamphlet describing the articulated four-wheel trailer truck of the type used under the Lima 2-8-4 type locomotive, first placed in service on the Boston & Albany, and setting forth the advantages of the large grate area the four-wheel truck makes possible in improving combustion and boiler efficiency. The truck is sold under patents controlled by the American Arch Company.

Locomotive superheaters.—The Superheater Company, New York, has issued the fourth edition of its Instruction Book on the locomotive superheater, giving instructions for installation, operation, maintenance and repairs. This book supersedes the edition issued in 1917 and contains 87, 4½-in. by 6-in. pages. It has been completely revised and gives the latest recommendations relative to the installation, operation and maintenance of the Elesco Type A superheater. Questions and answers in the back of the book cover the principle of superheating generally. The subject matter is well supplemented with illustrations.

Personal Mention

Master Mechanics and Road Foremen

H. Y. Harris has been appointed master mechanic of the Seaboard Air Line, with headquarters at Tampa, Fla.

E. J. English has been transferred as master mechanic of the Great Northern at Minot, N. D., to Everett, Wash.

W. A. King has been appointed road foreman of engines of the Seaboard Air Line, with headquarters at Wildwood, Fla.

F. B. Moss has been appointed master mechanic of the Richmond division of the Chesapeake & Ohio, with headquarters at Richmond, Va.

S. G. Clark, formerly traveling engineer of the Great Northern at Havre, Mont., has been promoted to master mechanic, with headquarters at Minot, N. D.

Robert G. McKee has been appointed master mechanic of the Chicago division of the Chesapeake & Ohio, with headquarters at Peru, Ind., succeeding E. R. Woody, who has been transferred to another point and assigned to other duties. Mr. McKee was born on April 20, 1885, at Rockbridge Co., Va. He attended the public schools at Bueno Vista, Va., and on May 1, 1903, entered the employ of the American Locomotive Works as a machinist apprentice. On March 5, 1904, he entered the Seventeenth Street shops of the Chesapeake & Ohio, and on August 5, 1904, was transferred to Clifton Forge, Va., completing his apprenticeship on July 15, 1907. From the latter date until January 1, 1913, he served as machinist and shop draftsman. He then entered the employ of the Baltimore & Ohio as a gang foreman at the Mt. Clare shops, Baltimore, Md., on October 1, 1913, returning to the C. & O. shops at Clifton Forge as shop draftsman and apprentice instructor. On January 20, 1914, he was promoted to gang foreman, and on May 1, 1916, transferred to Peru, Ind., as general foreman. On May 16, 1923, he was transferred to the Huntington shops where he remained until his appointment as noted above.

R. G. McKee

Shop and Enginehouse

L. F. Fife has been promoted to general foreman, motive power department, of the Southern Pacific, with headquarters at Sparks, Nev.

B. F. Madden has been promoted to the position of departmental foreman of the Southern Pacific shops at Sparks, Nev., succeeding L. F. Fife.

William A. Schipper has been promoted to machinist foreman of the Southern Pacific, with headquarters at Sparks, Nev., succeeding B. F. Madden.

J. O. McCann has been appointed boiler foreman of the Chicago & Alton, with headquarters at Slater, Mo.

W. H. Davis, acting night foreman of the Kansas City Southern, at Port Arthur, Tex., has been permanently promoted to that position.

W. H. Dillon has been appointed machine shop foreman of the Chicago & Alton, with headquarters at Slater, Mo.

W. J. Taylor, general foreman of the shops of the Southern Pacific at Sparks, Nev., has been transferred as general foreman to Sacramento, Cal.

J. R. Zeurick, general boiler foreman of the Baltimore & Ohio at the Ivorydale shops of the Baltimore & Ohio at Cincinnati, Ohio, has been promoted to general foreman, with headquarters at Flora, Ill.

Purchasing and Stores

A. N. Warner has been appointed storekeeper of the Great Northern, with headquarters at Breckenridge, Minn.

R. S. Simmons has been appointed storekeeper of the Great Northern, with headquarters at Williston, N. D., succeeding A. N. Warner.

G. F. Ohden has been appointed division storekeeper of the Illinois Central, with headquarters at Water Valley, Miss., succeeding W. E. Hoyt, deceased.

W. L. Wheeler has been appointed assistant general storekeeper of the Chicago & North Western, with headquarters at Chicago, succeeding D. W. Corcoran.

O. A. Donegan has been appointed general storekeeper of the Boston & Maine, with headquarters at Boston, Mass., succeeding J. E. Byron, who has been assigned to other duties.

D. W. Corcoran, assistant general storekeeper of the Chicago & North Western, with headquarters at Chicago, has been promoted to general storekeeper, with the same headquarters, succeeding R. M. Blackburn, who has resigned.

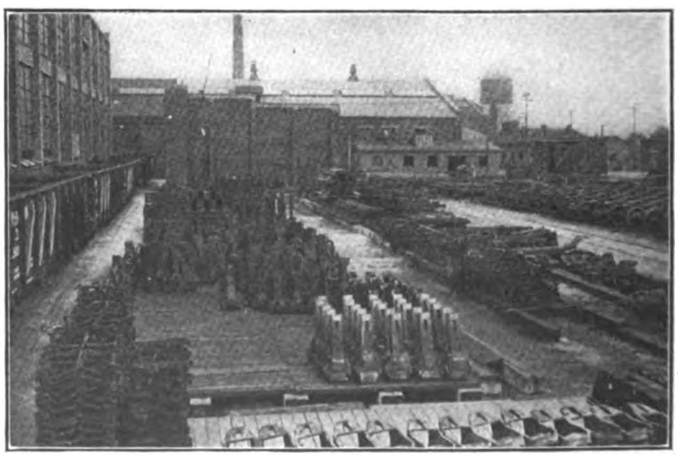
Car Department

F. M. Darden, assistant car foreman of the St. Louis-San Francisco, with headquarters at Springfield, Mo., has been appointed general car foreman of the west freight shop, with the same headquarters, to succeed G. W. Thomas, resigned.

Promotion of Sir Henry Fowler

Sir Henry Fowler, K. B. E., has been promoted from deputy mechanical engineer to chief mechanical engineer of the London, Midland & Scottish Railway, succeeding George Hughes, who retires. The news of Sir Henry Fowler's promotion will be of interest to numerous persons in the United States. During the war he was superintendent of The Royal Aircraft Factories for the British government, and while serving in that position visited the United States. He was a joint general secretary of the recent International Railway Congress in London and was active in making and carrying out the arrangements of the British railways for the entertainment of the foreign visitors.

He was formerly chief mechanical engineer of the Midland Railway and became deputy chief mechanical engineer of the London, Midland & Scottish when the program of amalgamation of British railways was carried out, in accordance with which the London & North Western, Midland and some other lines were consolidated into the London, Midland & Scottish. He has been president of the Institution of Locomotive Engineers, of the Institution of Automobile Engineers and of the University of Birmingham Engineering Society.



Neatly arranged material yard for a car department

Railway Mechanical Engineer

Volume 99 | DECEMBER, 1925 | No. 12

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SCHEDULED FOR NEXT MONTH

You will be interested in the new TEXAS TYPE LOCOMOTIVE.
It will be described in next month's issue.

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Railway Mechanical Engineer

Vol. 99 | December, 1925 | No. 12

Order your index now

The current volume of the *Railway Mechanical Engineer* closes with this issue. Only a sufficient number of indexes will be printed to supply copies to those of our readers who specifically request that a copy be sent them. If you want the index, therefore, place your order now, mailing it to our New York office, 30 Church street, New York.

Using the Railway Mechanical Engineer

Several preceding issues have contained in these columns suggestions of ways in which the *Railway Mechanical Engineer* may be made useful to mechanical department officers and foremen. These have dealt largely with what may be called organized or group utilization. The greatest value of the paper, however, comes to the individual subscriber whose reading habits lead him to scrutinize each issue as it is received so that he may be sure he has not missed any article dealing with a subject in which he is concerned, before he finally lays it aside. Just to illustrate, have you ever encountered difficulty in the maintenance of old Vanderbilt tanks? This issue tells you how one railroad has overcome this condition. Has the problem of effective staff meetings ever given you concern? In this issue you will find suggestions—in two places—on how not to handle staff meetings as well as on how they have been conducted successfully. Did it ever occur to you that the location of the whistle on the locomotive is a matter of importance? Are you satisfied with the present situation with respect to the transfer of lading from bad order cars? Are you interested in the application of the newly developed lacquer process to passenger coach finish? Is the matter of die construction for forging machines one with which you are concerned? If you are interested in these and many other questions pertaining to mechanical department affairs, do not fail to make full use of the *Railway Mechanical Engineer* by reading what others have accomplished in solving, or have to say concerning, these problems, in this issue.

Getting the most out of power hacksaws

Every machine tool is limited in production by the cutting tools that are used on it. Practically all types of machines have been developed to the maximum feeds and speeds that it is possible to obtain with the cutting tools now on the market. Much greater production could be obtained with practically every machine tool if it were possible to secure tools that would stand up under a heavier cutting schedule. Power hacksaw machines have probably been handicapped more than any other machine tool in this respect, because the manufacturer of hacksaw blades has lagged considerably behind the development of other cutting tools. As a result, some users do not consider the power hacksaw as a machine tool and will not give it the same study and consideration necessary to improve the production possible to obtain from it. In many shops, the cheapest kind of labor is used on these machines. They are not always kept in good repair, nor are they properly cleaned. Furthermore the cutting-off operations of which these machines are capable, are not given the same careful consideration which is given the milling, drilling or grinding machine. The purchase of hacksaw blades is often based on price alone. A careful study of a power hacksaw machine shows that it has many advantages over other types of cutting-off machines. It requires less power, is quicker to operate and requires less time to stop, move up the work and start again; the blade expense is less, it removes a much narrower kerf and the initial investment is much smaller. In the past there have been two objections to a machine of this type which have been overcome during the past two years; namely, blade breakage and crooked cutting. A modern power hacksaw will not break blades as long as the machine is in good condition, provided it is running at the correct number of strokes per minute and that the blades are of the correct specifications for the material being cut. Within the past year, several types of hacksaw blades have been placed on the market which are capable of utilizing the maximum capacity of a modern power hacksaw machine. A modern machine of this type represents a capital investment and should receive the same consideration as any other machine tool, in order that it may earn the greatest possible return. It should be properly maintained and consideration should be given to the selection of the blades which will utilize the capacity of the machine.

Possibilities of standard small tools

A great lack of uniformity exists in the small tools used for similar operations, not only in railroad shops and enginehouses on different railroads, but in the various shops and terminals on the same road. The arguments in favor of a certain amount of standardization of these tools are well known, consisting primarily of reduced cost to manufacture, consequent lower possible selling cost, and reliable products more uniformly adapted to perform the manifold operations in repairing cars and locomotives.

The American Railway Tool Foremen's Association took a step in the right direction at its convention last September when a regularly appointed committee of the association submitted for adoption certain general specifications for standard locomotive frame and rod reamers. The variation in reamer sizes, flute lengths, taper, spiral angle, type of shank, and one or two minor details were specified, and, after some discussion, the association voted to recommend the proposed reamers to the Mechanical

Division for consideration at the Atlantic City convention next June. If adopted as standard by all the roads, the result will be to reduce materially the number of kinds of taper reamers used in railroad shops and enginehouses. The Tool Foremen's Association is to be congratulated on its work in connection with these reamers, particularly in view of the well-known difficulty in getting any body of mechanical men to develop a standard design which will meet satisfactorily the varying needs of all the individual members.

Another tool which is under consideration for standardization by the Tool Foremen's Association at next year's convention is the boiler tap, and the problem of what general specifications to adopt in this case is complicated by the difference of opinion regarding the relative merits of Whitworth and V-type threads for boiler work. It would seem reasonable to assume, however, that one of these threads is in general superior to the other and the better one of the two ought to be adopted on all the railroads in the country. The manufacturers could then increase their production of that particular type of boiler tap and with the use of specialized high production machinery and methods turn it out at decreased cost.

This work of reducing to a certain extent the multitudinous variety of shop tools, and particularly the great number of expensive special tools used by individual roads, may well be encouraged and extended. With judgment in the determination of what tools can be properly standardized without a deadening effect on the development of new and improved tools, it will save the railroads money and prove advantageous to all concerned.

Mechanical department staff meetings

Few, if any, railroads carry out the idea of holding annual mechanical department staff meetings to the extent practiced on the Chicago, Milwaukee & St. Paul, under the direction of L. K. Sillcox, general superintendent of motive power. That the value of the meetings in the way of inspiration, education and the promotion of better feeling and unified action on the part of the mechanical department supervisory officers, more than justifies the effort and cost involved seems to be well established by experience on the St. Paul. In fact, since the inauguration of the staff meeting plan four years ago, the meetings have increased in size and importance, the men working harder each year in preparation for them and being more enthusiastic each year about the results accomplished.

The 1925 staff meetings began with that of the general, blacksmith and tool foremen held at Milwaukee, Wis., June 8 to 10, inclusive, at which 24 papers on selected subjects were read and discussed. Following this meeting within a period of two months, the air brake foremen met for a two-day session and discussed standard practices for the maintenance of air brakes, the meeting being divided as between the locomotive and car departments; traveling engineers from all over the system held a two-day session at which 16 papers were presented; the boiler foremen met in Minneapolis for a three-day session at which 17 papers were presented; the chief clerks, also divided as between the locomotive and car departments, met for a two-day session, in each case considering 10 subjects; the master mechanics held a three-day session, discussing 19 subjects; the car department also held a three-day session at which 20 papers were presented. The last of these meetings was held at Milwaukee, October 12 to 13, at which special apprentices discussed 17 papers pertaining to their work.

The mechanical department officers from the entire system so far as possible, attend these meetings, which are scheduled in such a way that the maximum number of men can be in attendance without interfering with service and the normal functioning of the mechanical department. Mimeographed copies of the papers prepared in advance are available to the members before attending the meetings and this enables a more studied and careful discussion to be maintained. A record of the discussion is kept which also subsequently becomes available to the men interested for further study and guidance in their work during the coming year. Unquestionably, the mechanical department staff meetings as held on the Chicago, Milwaukee & St. Paul, have had a most helpful influence in assisting the mechanical officers to understand their mutual problems better, in improving the acquaintance of these men and welding them into a unit in the furtherance of the better interests of the railroad they serve.

Utilizing shop schedules

Due to the varied nature of locomotive shop work it has always been more or less difficult to compile figures which will serve as a true indicator of shop production or output. To say that a locomotive shop turns out so many classified repairs in a given month is not by any means a sound basis for comparison of output, neither is a comparison of man-hours always a true indicator of production.

Several large locomotive shops in this country have, however, developed systems along with their shop scheduling systems which serve as a reasonably accurate indicator of output. These have been fully described in past issues of the *Railway Mechanical Engineer*, and it is sufficient to point out here that one such system is based on the principle of allotting a certain number of points for each locomotive which has been given classified repairs, the number of points depending, in general, upon the class of repairs, due consideration being given to the type of locomotive and whether repairs in a given class are light or heavy. With this system it is possible to determine the number of man-hours required to make a point, and a comparison of these figures serves to furnish at least a consistent basis of comparison of output.

In one shop using such a system a keen spirit of rivalry became apparent between different gangs which resulted in many original ideas being brought out to save time and labor on many jobs which were formerly done in a less efficient manner. The foremen throughout the shop are periodically furnished with reports showing the progress being made during the month, and in an effort to produce "points" with the least possible number of man-hours, every element of machine and erecting shop practice entering into production is carefully watched. In this manner many machine tools in that shop which had been rendering service for a great number of years were found to be the real reason why it was impossible to make a substantial reduction in man-hours on certain jobs. This led to the making of time studies on such machines in comparison with more modern machines recently installed for the same class of work with the result that those in charge of the shop were able to present to the management some real figures showing why new machine tools should be purchased.

Is it not possible that one of the reasons why many shops must get along with inadequate machine tools is because there has been no systematic effort made to find out just how much could be saved by the installation of more modern tools?

Locomotive shop scheduling systems were originally developed with the idea of increasing output. Some shops which have gone a little farther than others in develop-

ing the details of scheduling systems have found that it is possible to secure reliable data on many phases of shop operation which not only make it easier to perform the ordinary repair work but also furnish a comprehensive basis for the requisition of new machine tools and shop equipment.

Front end draft appliances

Railroad mechanical men don't need to be told that the arrangement of draft appliances in the front end has an important bearing on locomotive performance. Not every one realizes, however, that it is almost impossible to over-emphasize the importance of this feature of locomotive design. The fuel savings made possible by modern locomotive design and the incorporation of various auxiliary fuel economy devices can be completely nullified by improper arrangement of the draft appliances in the locomotive front end.

A striking example of necessity of front end adjustment to suit individual conditions was afforded by the tests of Missouri Pacific three-cylinder Mikado locomotive 1699 at the Altoona test plant, as reported on page 462 of the July, 1925, *Railway Mechanical Engineer*. When this locomotive was placed on the test plant it was believed that with proper combustion an evaporation of 59,000 lb. of water an hour could be obtained, but, on the first trial with a 6¼-in. exhaust tip, the evaporation proved to be only 48,000 lb., or almost 19 per cent less than was expected. The exhaust tip was then increased to 6½ in. and the stack fitted with an extension to within 15 in. of the nozzle. No improvement was obtained with this arrangement. A Pennsylvania Lls stack was then applied with the same 6½-in. exhaust nozzle and a basket bridge, and an evaporation of 46,440 lb. of water an hour obtained. In order to fill the stack, the exhaust nozzle was then increased to 7 in. in diameter, the basket bridge being retained and an evaporation of 55,000 lb. an hour then resulted.

The final change was to use a 7-in. tip with Goodfellow projections, this arrangement bringing the evaporation up to 59,900 lb. an hour and later to 61,680 lb. Retaining the 7-in. tip with Goodfellow projections the original front end arrangement was replaced except for the petticoat pipe and the evaporation immediately dropped.

It is obvious that thorough-going tests must be made to determine what draft arrangement in the front end will produce the best results. Otherwise locomotives will waste fuel probably in sufficient amount to counterbalance anticipated savings from the application of superheaters, feedwater heaters, brick arches, syphons and other fuel saving devices. Not only is it essential that the dimensions, proportions and arrangement of draft appliances in the front end be suited to each particular class and possibly to each locomotive, but steps must be taken to assure that the correct front end arrangement, once established, be maintained.

A master mechanic of a large road was recently asked by his chief what size exhaust tip was being used on a certain class of locomotives handled at his terminal. In reply he stated that it was a 6½-in. tip. The chief asked him if he was sure, and he replied somewhat heatedly in the affirmative. A subsequent check of exhaust tips on eight locomotives of this class indicated that only one had a 6½-in. tip, the exhaust tips on the other locomotives varying from ⅛ in. to ¾ in. in size.

The necessity of giving unceasing attention to the maintenance of draft appliances in locomotive front ends is apparent.

New Books

Principles of machine design. *By C. A. Norman, professor of machine design, Ohio State University. 710 pages, illustrated. 5½ in. by 8½ in. Price $6.50. Published by the Macmillan Company, New York.*

This important addition to books in the engineering field covers somewhat more than the average text book on the subject. It teaches not only how to describe and how to design, but it goes further and contains computations carried through in detail for elements or combinations of elements, forming part of a specified whole, in numerous types of machines. Of the 585 illustrations, many are line drawings and photographs of actual machinery which show clearly not only the general make-up, but also good proportions and assemblies. In addition, there are a number of diagrams illustrating theory and computation. Much detail information and many numerical tables, not generally accessible, are included in the book. These will be found a distinct aid to designers and other engineers desiring this data for reference. For the practicing engineer the book furnishes up-to-date standards with regard to riveting, screws, sprockets, gears, etc., and also gives a collected and fairly simple treatment of modern experience and research, both here and abroad, regarding such matters as wear factors for gears, design of helical gears, belt action, belt loads, laws of lubrication, bearing loads, pressure drop in pipe lines, and other similar problems of design.

What Our Readers Think

The evaporative capacity of locomotive boilers

Philadelphia, Pa.

To the editor:

Our present knowledge of boiler performance must be largely based on empirical data and moreover we are only concerned with such performance for a definite range of operation. From this point of view, simplicity in formula giving a good approximation is the most desirable. On the other hand, aside from mere satisfaction, research or fundamental advance in design demands approaching the phenomena from the most rational basis irrespective of the complications, provided some sicplicity can be obtained in the ultimate results. Considering, however, the flexibility in design as to heating surface, etc. With resulting good efficiencies and the precision of measurements for this kind of work, it is clearly seen that boiler performance at best can only be approximated. Therefore, the degree of refinement in the analysis must keep this concept always in view.

Equation *6* in the first part of Mr. Poperev's article, published in the August issue of the *Railway Mechanical Engineer*, appears logical and his arrangement in the subsequent equations showing the nature of the losses is, all told, a valuable contribution. It is to be noted, however, that various coefficients of the equation are only applicable to one particular boiler of a given type. In the subsequent work, however, Mr. Poperev attempts to correlate these coefficients to account for the various proportions, detail geometrical configurations, types, etc., found in the boilers examined, in the forms of curves or definite functions, the primary variable being the ratio of the heating surface H to grate area G. This is, in my

opinion, exactly the weak spot of his analysis, because there is considerable flexibility in the coefficients proportional to the losses for different ratios of H/G depending upon the configuration and location of the particular percentage of the heating surface, relative firebox volume, etc. It is admitted the ratio H/G is an important constant characterizing the performance of a boiler, provided, of course, boilers of nearly the same configurations are compared. On the other hand, it is equally well recognized that firebox volume to grate surface is of great importance and Mr. Poperev's analysis in no way properly takes this ratio into consideration. Variation in the superheater surface and its configuration in the boiler, the brick arch, length, spacing and diameter of tubes, etc., effect to a more or less degree the efficiency for a given value of H/G. Therefore, the refinement proposed in the analysis is inconsistent with the lack of proper account of the several variables found in the comparison of the various types of boilers.

The formulas proposed by either Dr. Goss or Lawford Fry, appear satisfactory, since they account with sufficient accuracy the performance within the range of operation of locomotives in a much more simple form. Mr. Poperev condemns these formulas, primarily since they do not satisfy limiting conditions, as the initial conditions of zero efficiency at very low rates of combuston, etc. Since, however, we are concerned only with a definite range of operation, it must be admitted, that the simplest equation approximating this particular zone is the most desirable and that a good approximation can be made without necessarily satisfying initial conditions.

Neglecting the error for extremely low rates of combustion which is outside the field of operation, the assumption that the efficiency varies as a linear function of the combustion rate appears sufficiently accurate to account for the actual performance curve of a locomotive boiler. It is to be noted that Mr. Fry's assumption as to the variations of efficiency is in accord with other investigators in the field. Moreover, it would seem that the assumption of a linear function within the range of operating rates of firing is as logical as Mr. Poperev's assumption of a second degree equation for the rate of evaporation to the rate of combustion. Assuming the linear function for efficiency variation, we arrive at a quadratic form for the rate of evaporation to the rate of combustion which satisfactorily accounts for a rate of combustion that may occur within the range of operating firing. With coefficients derived from the efficiency linear equation, the resulting quadratic equation of the evaporation against combustion, fits the actual curves.

Fundamentally, we are concerned with three quantities for estimating and comparing the performance of a locomotive; first, the availability or potentiality of the steam for entrance to the cylinders; second, the efficiency of the card cycle or the cylinder efficiency, and third, finally the efficiency of transference of the heat from the combustion of the coal to the steam in its particular potential form. The latter, the "boiler efficiency," is dependent upon the efficiency of combustion, the magnitude of radiation and the efficiency of heat transference through the tubes. The loss due to combustion, a very important loss, obviously increases with the rate of combustion, but on the other hand, is greatly dependent upon the proportions of the firebox, the proper circulation of air, etc., and probably varying as some inverse function of the volume of the firebox. The radiation in the firebox is of a very uncertain magnitude, some claiming it to be directly proportional to the grate area, others to the firebox surface, etc. It is probably a complex function of both firebox surface, grate area as well as the geometrical configuration and volume of the firebox where in the simple form of the Boltzman Stephan law of radiation must be considerably modified. The availability of heat for transference to the tubes depends at the offset upon the total temperature head of the heated gases and therefore indirectly upon the exact nature of the preceding combustion and radiation phenomena. Then in addition, the heat transmission per unit area of tubes along the tubes depends upon the temperature head for that part, the velocity of the gases through the tubes, the degree of circulation depending upon the spacing of the tubes, etc., and finally on such details as the magnitude of soot, grease, etc., along the tubes. The law of heat transference must be modified for tubes with superheater elements. The cross section area of these to the total tube area is an important ratio for the heat transfer in the tubes.

In conclusion, therefore, it would seem that if a more elaborate method is offered for the analysis of boiler performance, it should consistently be based upon closer physical assumptions, rather than follow the more approximate assumptions used in the older methods which when used in their present forms are sufficiently accurate for the approximate comparisons of performance in which they are ordinarily used. R. Ekserglan,

Engineer and technical assistant to the vice-president, Baldwin Locomotive Works.

Is the A. R. A. overlooking a good bet?

Kansas.

To the editor:

In doing a first-class job of getting along, giving better service than ever thought possible, higher wages, higher material costs, increased taxes and other financial burdens are causing the railroads to economize in every phase of the game. The great forum of railroading, the American Railway Association, has done much to promote efficiency and with its seven divisions, the material and tangible side of the question is most thoroughly covered. The by-laws of the A. R. A. provide for the following divisions and prescribe the duties and limits of each: Division I—Operating; Division II—Transportation; Division III—Traffic; Division IV—Engineering; Division V—Mechanical; Division VI—Purchases and Stores, and Division VII—Freight Claims.

Various railroads have departments for helping those outside their own ranks in an educational way and do this through agricultural and industrial departments with competent specialists. Only a small number of the roads have any sort of training for their own mechanical department employees, or have any officer dealing with the human side of railroading. On the roads where this is being considered, personnel departments are doing the human engineering and regularly constituted apprentice departments through their schools are carrying on the educational work. Personnel work on railroads is a comparatively new idea but apprentice training has been successfully tried and proved over a span of two decades. However, there is no medium through which the heads of these departments can meet and work for general betterment in this respect.

The logical place for such a group is within the A. R. A., which association, if it does not believe the subject large enough for a special division, is overlooking a good bet in not having a standing committee in Division V to work out mechanical department educational and personnel problems, bending an effort towards making the 60 per cent of mechanical department expenditures (for labor) more productive, keeping pace with the improvements along all other lines of the business of transportation. Educator.

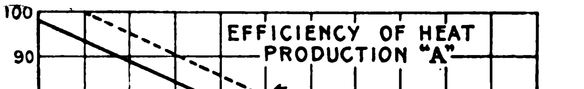
Locomotive test plants—Their influence on design*

Progress made during the past 20 years makes further advance more difficult—Exact knowledge is essential for future development

By Lawford H. Fry
Metallurgical engineer, Standard Steel Works, Burnham, Pa.

No study of locomotive development and operation can be complete without full consideration of the work done by the locomotive testing plant at Altoona, Pa., as the results of this work have materially influenced locomotive design not only in this country, but abroad. W. Rowland is designing locomotive boilers in England by methods developed largely from test data obtained at the Altoona test plant and his formula has been adopted by the Railroad Board of India as a basis for its official method of estimating locomotive boiler evaporative capacity.

It is possible on a modern testing plant to operate any given locomotive through its whole range of power. Within this range any desired combination of conditions, such as speed, cut-off, etc., can be selected and maintained constant during a run of an hour or more, and while running under such constant conditions, measurements can be made with laboratory accuracy and completeness. It is this combination of constancy of conditions and accuracy of measurements which gives the tests made on a testing plant their great advantage over road tests of locomotives. Road tests with a dynamometer car are valuable for checking and completing information obtained on the plant as to draw bar pull, but in all questions of steam production and consumption, the plant results are far more authoritative. There is much detailed information which now controls locomotive design which it would have been practically impossible to obtain without a locomotive test plant.



Locomotive-boiler efficiencies in relation to rate of firing

The locomotive testing plant is of purely American origin, and though the results of the tests made here have been much studied abroad, no real testing plant has been installed outside of the United States. The first locomotive testing plant was designed and erected at Purdue University under the supervision of Dr. W. F. M. Goss, in 1891. Locomotive testing plants have, therefore, been in use for over 33 years, that is for one-third of the century during which steam locomotives have been used in America. The growth in locomotives since the first plant was installed may be measured by the fact that the first locomotive tested at Purdue was a 4-4-0 type, a representative passenger locomotive of that date, weighing in working order about 85,000 lb., while the most recent Pacific type passenger locomotive tested on the Altoona plant had a weight of 309,000 lb., or more than three and one-half times as much.

Altogether six locomotive testing plants have been built and operated. One at Purdue built in 1891, two built by the late Robert C. Quayle of the Chicago and North Western in 1894 and 1895, and one at Columbia University in 1899. These four were all of small capacity, and with the exception of Purdue have been abandoned.

The first modern locomotive testing plant capable of handling locomotives of various designs was that of the Pennsylvania Railroad built in 1904. This was designed by the late Axel Vogt, then mechanical engineer, assisted by W. F. Kiesel, Jr., the present mechanical engineer of the Pennsylvania System. This plant was first installed at St. Louis, Mo., for the Louisiana Purchase Exposition in 1904, and after operating there throughout the exposition it was transferred to its present location at Altoona.

The latest plant is that at Illinois University built in 1914 under Dr. W. F. M. Goss when dean of the College of Engineering, and Prof. E. W. Schmidt in charge of the Department of Railway Engineering. This plant follows the general design of the plant at Altoona, but provides elaborate arrangements for catching the sparks and cinders thrown out of the stack.

The bulk of the work from the various plants comes from the Purdue and the Altoona plants. The Chicago & North Western plant was of considerable service to the early American Railway Master Mechanics Association committees on exhaust nozzles. The Illinois University plant has published two reports on tests, one describing

*Abstract of paper presented at the regional meeting of the American Society of Mechanical Engineers, Altoona, Pa., October 5 to 7, 1925.

complete tests of a consolidation locomotive, the other covering tests with six sizes of Illinois coal.

The majority of the work at Purdue has been done with the two 4-4-0 locomotives built for the plant. Of these, the earlier weighed 85,000 lb. and was replaced in 1897 by a locomotive weighing 109,000 lb. which was later superheated. With this locomotive the general characteristics of locomotive operation have been studied. The most elaborate and the latest work is given in two reports published by the Carnegie Foundation in 1907 and 1910. These cover two series of tests by Dr. Goss, studying the effect on boiler and engine operation, of variations in steam pressure and variations in superheat. The information given by these and by earlier tests is of general value to a designer endeavoring to secure a proper balance between cylinder power and boiler capacity.

The installation of the Pennsylvania Railroad locomotive test plant at the St. Louis Exposition in 1904 opened a new and important era in locomotive testing. Earlier plants had been adopted only for testing light four coupled locomotives. The Pennsylvania plant was capable of handling locomotives of much greater weight and more varied design. Immediate use was made of the greater plant capacity. The series of tests made at St. Louis covered eight locomotives of widely different designs, and the data secured and published was far more complete than any previously available. These tests were the first to furnish sufficient information to enable heat balances to be drawn up for a locomotive boiler. Such balances were computed and published by the writer in 1908, and gave for the first time exact knowledge as to the relative importance of the various losses which determine the efficiency of the locomotive boiler. Since the transfer of the plant to its present location in Altoona, much work has been done in testing new locomotive designs as produced, and in providing a constantly accumulating mass of information which has made possible continued improvements in design. The greater part of the activity of the plant in Altoona has been carried out under J. T. Wallis, now chief of motive power, Pennsylvania System. Direct charge of the test plant was in the hands of C. D. Young, engineer of tests, from November, 1911, to May, 1917, and is now in the hands of his successor, F. M. Waring.

The great influence which the work done on the Altoona plant has had on locomotive design is indicated by the following statements as to the work done and conclusions reached. These are abstracted from the Pennsylvania Railroad's test plant bulletins as shown by the reference numbers.

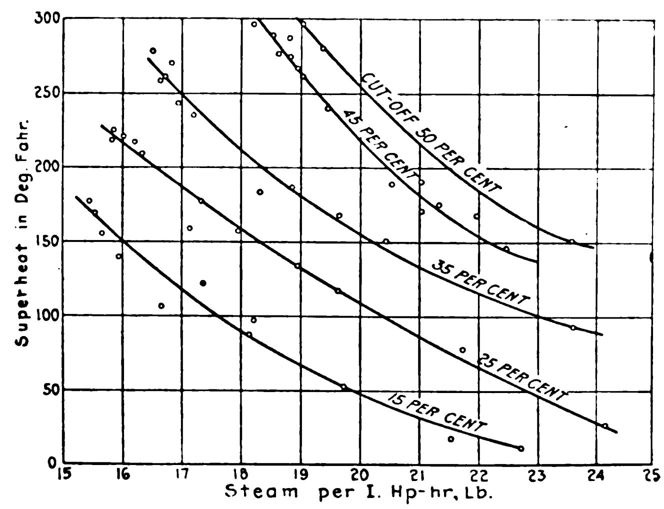
Bulletin No. 9.—A self-cleaning front end was developed which gave better results than the design recommended by the Master Mechanics Association.

Bulletin No. 21.—A comparison was made between the results obtained with long and short boiler tubes. It was established that the rate of evaporation is limited by conditions of combustion and not by a failure of heating surface to absorb heat.

Bulletin No. 23.—It was shown that a diameter of 12 in. was sufficient for piston valves for cylinders up to 27 in. in diameter, when superheated steam was used. Subsequent tests showed that valves of this diameter could be used with 30-in. cylinders with the cut-off limited to half stroke. Measurements of the stresses in the valve stems gave definite figures showing that the valve gear could be lightened to advantage by using valves of the minimum size.

Bulletin No. 24.—An extensive series of experiments on superheaters of various designs produced data showing steam consumption for varying conditions of superheat, cut-off and speed. These tests gave for the first time authentic information unobscured by other variables, as to the effect of variations in superheat on steam consumption.

Bulletin No. 27.—As a result of earlier tests on the plant, certain changes in the design of the E-6s Atlantic type locomotive were recommended. Tests of the locomotive redesigned as recommended gave a maximum evaporation 15 per cent greater, combined with a boiler efficiency nine per cent better than the original locomotive. At the same time the engine performance was generally better so that a higher drawbar pull was developed at all speeds and the maximum drawbar horsepower was increased over 20 per cent. These advantages were secured with an increase in total weight of only 2.5 per cent. Careful design of the reciprocating parts enabled them to be kept down in weight so that the dynamic augment at



Effect of superheat on steam consumption at various speeds and cut-offs

70 m.p.h. was less than 30 per cent of the static load on the drivers.

Bulletin No. 29.—Tests were made with a K-4s Pacific type locomotive built in 1914 in accordance with recommendations and experience obtained with locomotives of earlier designs on the testing plant. The coal and water rates and the high thermal efficiency showed this to be the most economical passenger locomotive so far tested on the plant. For any given amount of fuel fired, this locomotive developed more power than any previously tested at the test plant.

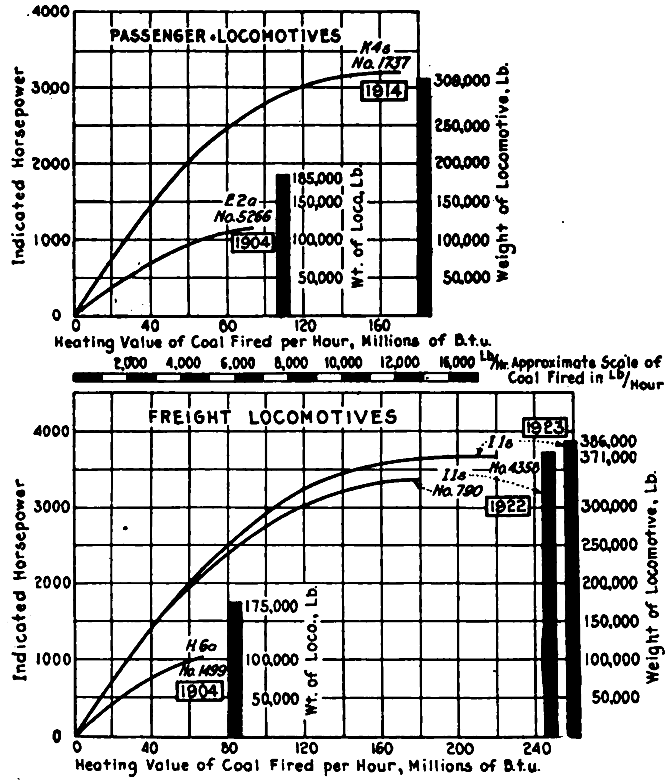
Bulletin No. 30.—Accurate tests demonstrated the advantage gained in boiler efficiency by the use of a brick arch when high volatile bituminous coal is being rapidly burned.

Bulletins No. 31 *and* 32.—The testing plant having shown definitely the great difference in steam consumption between cut-off at full stroke and cut-off at half stroke it was logical to attempt to produce a freight locomotive which, even in low speed drag service could operate at cut-offs of not over 50 per cent. The result was the development of the Ils Decapod class locomotives with a boiler pressure of 250 lb. per sq. in., instead of 205 lb. and with cylinders enlarged to enable full power to be developed without using a cut-off longer than 50 per cent of the stroke. Compared with the previous standard freight locomotive, the new locomotive with an increase of 16 per cent in weight gave an increase of 25 per cent in power, and in full gear at low speed showed a reduction of 38 per cent in steam used per indicated horsepower. This type of locomotive with feedwater heater added, giving a further increase of two per cent in indicated horsepower, is now

the standard freight locomotive of the Pennsylvania System.

One of the charts has been prepared to show the growth in the size and efficiency of the passenger locomotives of the Pennsylvania Railroad since the test plant was put into service. The E-2a Atlantic type locomotive of 1904 is compared with the K-4 Pacific type locomotive of today. The curves show the indicated horsepower in relation to the rate of firing. The heavy vertical lines represent the locomotive weights. The weight has increased from 185,000 lb. to 309,000 lb. The maximum horsepower has increased from 1,200 hp. to 3,300 hp. The increase in power has been much more rapid than the increase in weight. This can be seen from the fact that the indicated horsepower developed per 1,000 lb. of locomotive weight has increased from 6.5 hp. to 10.7 hp., that is, by 65 per cent.

So far we have described the work of the Altoona test plant by abstracts from the bulletins which deal mainly with the solution of concrete problems arising out of the testing of certain definite designs of locomotives. The test plant has, however, been of great value in providing material for a study of locomotive operation in general terms and in thus advancing our knowledge of the subject. Probably the greatest advance has been made in knowledge pertaining to the factors which determine boiler efficiency. Before the Pennsylvania test plant results had



Growth in size and efficiency of steam locomotives

been studied, speculation was active as to the best proportions to be assigned to firebox and heating surface, but our definite knowledge was scanty. Dr. Goss's work had indicated that the losses by incomplete combustion were large, but with no information as to the amount of air consumed, accurate knowledge as to the details of combustion and heat absorption was lacking. The Pennsylvania test plant has changed this. During the recent tests of the Missouri Pacific three-cylinder locomotives, the writer was shown a curve of estimated smokebox temperatures drawn up before the tests were started. These, in the majority of cases, did not differ from the results actually obtained by more than 15 deg. F.

All locomotive boilers show a drop in efficiency with an increase in the rate of operation, and if the efficiency is plotted against the rate of firing it is found that the relation is best expressed by a straight line. The straight line for the boiler efficiency of the K-4s Pacific type locomotive is shown on the chart of boiler efficiencies in relation to rates of firing. The Pennsylvania test plant results if analyzed enable us to split up this overall boiler efficiency into two components—

a—Efficiency with which heat is produced.
b—Efficiency with which heat is taken up by boiler.

These component efficiencies follow closely straight line laws, as shown on the chart.

The information thus secured is important in any attempt to improve the boiler efficiency. The line for the efficiency of heat absorption shows but slight variation with the rate of firing, the values being uniformly high, ranging from 86 per cent to 80 per cent. These figures represent the heat taken up as percentage of the heat actually produced. Now the smokebox gases cannot possibly be cooled below the temperature of the water in the boiler. Therefore, not all of the heat produced is absorbable by the boiler. It can be computed that the boilers in question are taking up between 94 per cent and 88 per cent of the heat which it is physically capable of absorbing. This is characteristic of modern locomotive boilers, and it is evident that as pieces of heat interchange apparatus they are highly efficient and that there is but a small margin for improvement in heat absorption.

The efficiency of combustion shows a different condition. Here an efficiency of 100 per cent is possible and is shown by the tests to be reached at low rates of combustion. At the ordinary rates of operation, however, usual values are in the neighborhood of 60 per cent or less.

There is evidently a considerable field for improvement here, but it must not be assumed that improvement is easy. There is necessity for considerable study before the final answer is given. The diagrams show that boiler efficiency can be improved by reducing the rate of firing per sq. ft. of grate area. If the same power is to be maintained this means an increase in the size of the grate so that the total amount of coal burned may be maintained. Locomotive designs adopted by various railroads in the last few months show development along this line, but as yet no locomotive testing plant analysis of performance is available.

In this connection, the writer calls attention to the fact that in the discussion of boiler efficiency in relation to the rate of operation it is usual, as has been done above, to measure the rate of firing in terms of coal per sq. ft. of grate area per hour. This assumes that the grate area is the controlling factor in determining the efficiency of combustion. Grate area is an important factor, but not the only one. Firebox volume must also be given consideration.

The test plant data is not yet sufficiently complete to permit a determination of the relative values of grate area and firebox volume, but one series of tests with high volatile coal suggests that with this fuel the volume is the more important. The point deserves more study and it may be found that combustion efficiency can be best improved by a slight increase in grate and a considerable increase in firebox volume with appropriate arrangements for giving a long flame-way.

The question is extremely complex and can be most adequately answered by further test plant work. Doubtless this is but one of many problems by the solution of which the locomotive test plant will advance still further the development of the steam locomotive.

For the future we look with confidence to a continued

growth in the use of the locomotive testing plant. The great increase in locomotive efficiency which has taken place in the last 20 years makes further advance more difficult, and makes exact knowledge a necessary condition for such advance. As it is the function of the locomotive test plant to provide exact knowledge it is not surprising that new plants are under consideration by railroads and by locomotive builders. A great step forward could be made if the American Railway Association were to construct or to take over a locomotive test plant to be devoted to the scientific and impartial study of locomotive designs and devices and to research work concerned with the basic scientific laws governing locomotive operation. Correct locomotive design is only possible when the definite natural laws governing locomotive operation are known.

The foreman and his responsibility

Two more of the contributions which were submitted in the competition on this subject

So much attention has been given by our readers to the articles by contributors to the *Railway Mechanical Engineer* competition on the foreman and his responsibilities and opportunities that the following contributions have been selected for publication:

A roundhouse foreman's viewpoint

By Charles Frederick Maw

Locomotive foreman, Canadian National, Grand Trunk Lines in England, Island Pond, Vt.

A prominent railroad official was recently heard to say "The roundhouse foreman is one of our main keys to success." Let us see for a moment how this works out. Railroads are carriers and must have motive power. To efficiently handle and prepare the power of the various American and Canadian railroads an army hundreds of thousands strong has to be maintained. Every roundhouse, machine shop, or main shop is a busy hive of industry with its necessary quota of charge hands, gang foremen, etc., under the supervision of the locomotive or general foreman, as the case may be.

The importance of the foreman's position is obvious. He is the one man oftentimes standing between the officers or management and the employees. On his shoulders fall the responsibility of rightly or wrongly interpreting the policies laid down. To be a foreman in every sense of the word requires certain essential qualifications without which, if the foreman holds down his job, he is merely *just getting by*.

A foreman's qualifications

1. He must be a man as well as a foreman. If he has worked up from the ranks, he is cognizant of the many little troubles which daily confront the mechanic and by a judicious word here and there, can immeasurably improve the efficiency of the staff. Firmness is necessary and rightly so, but it should be tempered with good judgment and common sense. Creating "sore heads" gets nowhere.

2. He must have a good general knowledge of all duties under his supervision. I remember some years ago, a man was promoted to roundhouse foreman because of his exceptional ability at valve setting. He proved a failure. Why? Because, while he had made a determined and praiseworthy effort to master the subject of valve setting, he had studied practically nothing else and knew little or nothing about the handling and supervising of men. The foreman must be more versatile than any other man on the railroad system. Besides being of at least average mechanical ability, he must be alert to grasp the detail of the thousand-and-one things of other than mechanical nature which come under his jurisdiction.

3. He must be an organizer. This is especially the case with the roundhouse foreman. Just as raw troops, well led, have accomplished at times almost the impossible, so the roundhouse force measures up its foreman and matters progress or retrogress accordingly. His, the eye to note, as he daily goes his rounds, the weak links in the chain. His, the mind to plan and then he, the person to enthuse his charge men, gang foremen, shop foreman, boiler foreman, etc. He should encourage good work but should also make adjustments, as the service demands, without fear or favor. He should cover the whole territory under his jurisdiction at least once every day.

4. He must be approachable and diplomatic. A great deal depends on the manner in which the foreman receives a deputation of organized labor. He must uphold the policies of his employers and at the same time be courteous with the representatives of the men. If at the time it is impossible to grant their request, he must so advise them in a diplomatic manner. Likewise, when a change of policy is brought about by his employers, he must endeavor to bring this about in the roundhouse, shops and works without antagonism or estrangement. To use an expression of an old friend of mine: "A few drops of oil are oftentimes worth many tons of sand," in cases of this nature.

The personal touch so lacking in these days of organized efficiency is a great asset to the foreman fortunate enough to possess it. In small communities, the foreman is often looked to by the men as a standard by which to set their moral gages. Fortunate indeed is he who can leave a small city or town after a few years' service as locomotive foreman with the general good will of the community and the record, *"he was a square boss."*

5. The foreman must be resourceful. Oftentimes tried in the past and daily tried again is surely the foreman's lot. He frequently lacks material and must substitute (which he seldom fails to do) something equally as good. The power must be maintained and the business moved or the road suffers. The passenger power must do the job and run to schedule or the public is heard from and it begins to use the passenger trains on another road. Passenger returns drop off. The traffic department hunts in vain for business. Dividends come not. All because the little known and generally misunderstood locomotive foreman is not doing the job. Change the scene, however, and with a live wire foreman everything is prosperity, so far as efficiency of power is possible to make it so.

Lastly, the foreman should be looking ahead. Do the

railroads give their foreman the encouragement he oftentimes deserves? Do they realize the time he puts in studying and working to improve himself that their service may be more expeditiously and efficiently handled? Surely this is one thing to which the foreman is entitled. He has to be an administrator of no mean ability to ensure success and employers should give him every encouragement and also every possible opportunity for advancement.

Must study the men

By William J. Eagan
Lehigh Valley, Sayre, Pa.

Relationship of the foreman to his men is a study which requires more than superficial examination. He is the compound which cements the man to the company in spirit as well as in practice.

He should show that he has confidence in the ability of the men under his charge to do the work assigned to them without constant watching and suggestions from him—nothing makes a force more disgruntled than the knowledge that it is being constantly watched or thought incompetent.

If a man is not properly placed he should be transferred and placed on a job that he can handle efficiently; a supervisor flagrantly displays his own incompetency by holding a man on work which he is not capable of performing efficiently.

How often do we go through a shop and see the foreman performing duties that can easily be taken care of by laborers? When the men see this going on continually, they lose confidence in the ability of the men higher up to choose leaders in the shop, and most of them have aspirations terminating, at least temporarily, in a foremanship.

A foreman should be firm without being arrogant, especially when approached by a man with a grievance. Listen to him, and if you can't adjust it at once, give him every assurance that it will receive consideration. Likewise, if he has a suggestion for an improvement in a method to increase production or for safety first, or that will better the appearance of your department, encourage the suggestion, recognizing the fact that a foreman is only as strong as is the force under him. See also that a man receives recognition from the office for such diligence. Too often the foreman has overlooked such suggestions or acted upon them as his own.

Give your time to the company unstintingly, even though there is no direct compensation from the additional effort; a foreman or man who is looking from one pay day to the next has about reached his limit, and a foreman who has that attitude will quickly relay it to his men. The company isn't a place to get a living from so much as an organization that gives a living and an opportunity to succeed.

Don't play favorites, because when they are placed upon their own feet they usually topple, and a system loaded with favorites shunts all the work upon one or two men—such an organization will fail of its own weakness. Remember, always, that an organization is only as strong as its president, and he is as strong as the assistants he picks to help him, and so on down through the whole production family to the most unskilled man. Any weak link reflects upon the man choosing or holding him.

Rock Island remodels Vanderbilt type tenders

Tank of new design applied to standard underframe—Capacity increased to 10,000 gal.—Maintenance cost reduced

The Chicago, Rock Island & Pacific has embarked on a program of improving and rebuilding 107 Vanderbilt type tenders used in conjunction with 30 Pacific, 75 Mikado and 2 Mountain type locomotives in service on that road. The cost of conversion will be about \$3,500 a tender and it is estimated that the new design will pay for itself in reduced maintenance cost within a period of slightly over four years. The original Vanderbilt tenders, purchased in 1912 and 1913, were always subject to excessive maintenance cost, owing to the fact that buffing stresses were transmitted through comparatively light plates and angles to the tanks and when the holding rivets worked or sheared off, leakage resulted and the tenders had to be taken out of service. This condition gradually became worse as the tenders got older and plates forming the lower half of the tank circle corroded and deteriorated.

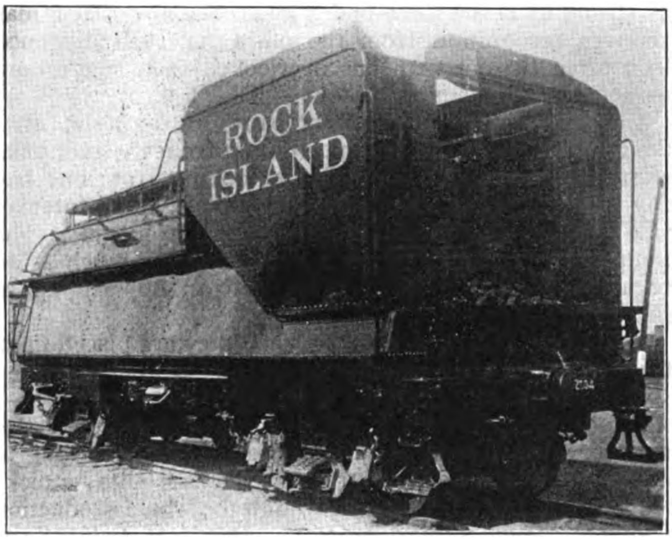
A careful individual check was kept of the expense of repairing eight Vanderbilt type tenders on the Rock Island, the figures showing an average cost of \$864 every 12 to 18 months, or in fact each time the locomotive came to the shop for heavy repairs. This excessive cost, in conjunction with service delays owing to the development of leaky tanks on the road, eventually became so serious that it was evident some determined effort must be made to meet the situation. The weaknesses of the old tender design were studied and, under the direction of W. J. Tollerton, general superintendent of motive power, and George Goodwin, mechanical engineer, a new design developed which gives promise of solving the problem.

By the new design the tank of the Vanderbilt tender is completely remodeled, the lower half containing the deteriorated plates being cut away with the oxy-acetylene torch, and a new bottom substituted which is expanded to the full width of the tender at the bottom and is anchored in the customary manner to the conventional design of four-sill tender frame. The new construction is indicated in the drawing and photographs.

While some additional capacity is gained by widening the tank at the bottom a certain amount is lost through cutting off that part of the original tank cylinder which extended below the top of the present tender frame. The tank length in the new Rock Island design has been in-

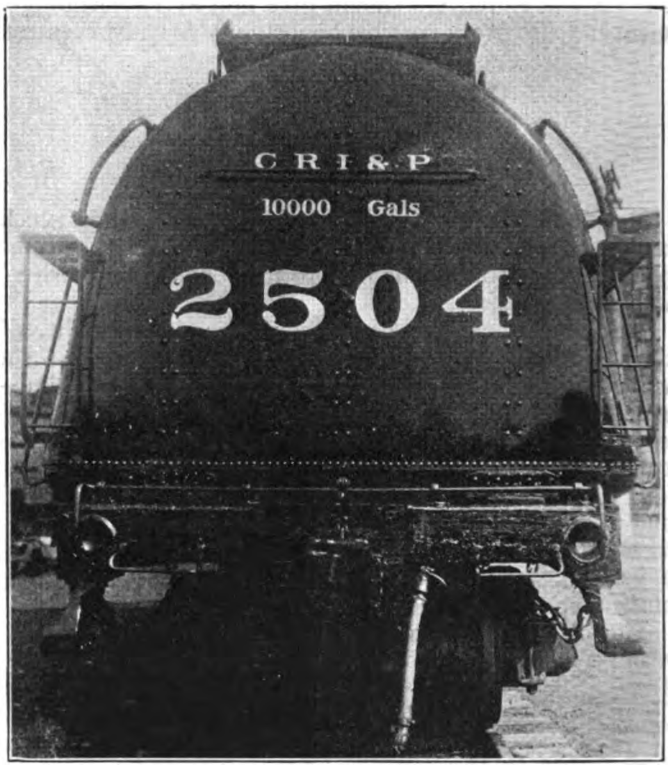
creased 30 in. which gives a net added capacity of 1,000 gal., or a total capacity of 10,000 gal. It is obvious that a still further increase in capacity could be obtained by adding a suitable amount to the length of the tank and providing trucks to take care of the increased load. The coal space has not been changed. In case the tender is to be used with a stoker-fired engine, however, a trough for the conveyor screw can be readily provided in the design of the new tank bottom.

Referring to the drawing, the changes made in the old



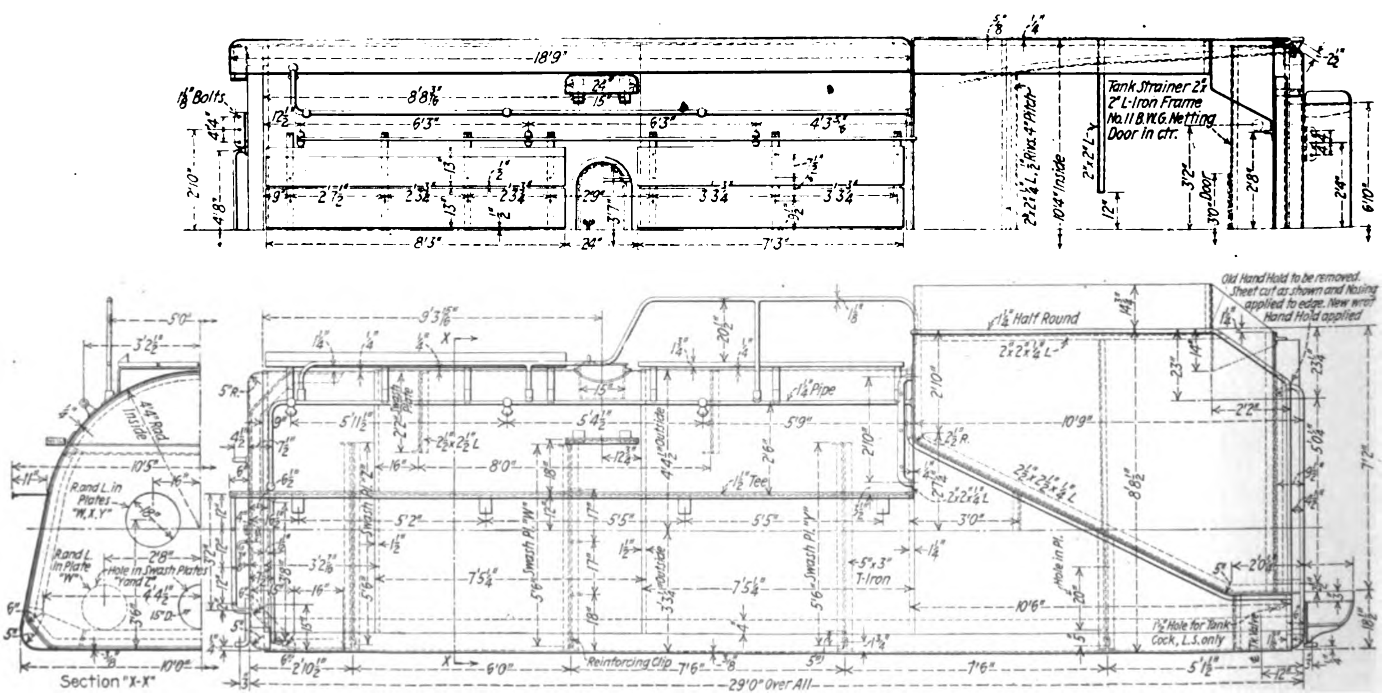
Vanderbilt tender remodeled and rebuilt in accordance with Rock Island design

Vanderbilt tank will be evident. The upper cylindrical course has been bent out on each side and new courses added, to be joined to the new bottom plates by riveted joints. The bottom of the new tank, which contains practically no rivets, would be made of a single plate if one of the desired size could be obtained but, lacking that, two plates are used, joined by a reinforced, electric, butt-welded joint along the center line of the tank. It will be observed that the bottom plate does not come to a sharp corner and join the side plate by being riveted to one flange of an angle iron as is customary with rectangular tanks. Instead, the edges of the bottom plate are bent to a 5-in. radius and riveted directly to the side plates. This eliminates one joint, leaving but a single joint which



The tank, expanded at the bottom to the full width of the tender, is supported on a standard tender frame

is in such a position as to be easily caulked, and giving a more flexible construction. This particular feature of the remodeled Vanderbilt tanks has been thoroughly tested on the Rock Island and shown to be a big improvement over the angle iron corner construction which not



New tender design developed by the Rock Island to overcome weakness inherent in its Vanderbilt tenders

only has the additional joint but offers so rigid a resistance to the weaving action of the tank under the surge of the water that something must give and as a result the plates or angle irons crack or rivets work loose.

Another feature which tends to prevent leaky corners with the new design is the provision of special, continuous, U-shaped braces to stiffen the lower half of the tank and make it retain its shape under stress. There are three of these braces, made of 5-in. by 3-in. T-iron, and by forming the sides and bottom of each brace of one continuous piece it is possible to get away from the weak construction of having side braces which terminate at the bottom corner of the tank and cause leaky rivets at that point under the weaving action of the tank. As shown in the drawing, the braces are not fitted exactly to the corners of the tank but the change in direction from the sides to the bottom is accomplished by two bands of 6-in. radius each and a short section of 45 deg. slope. The back head of the tank is new and the splash plates are fitted with new T-irons. The running boards are raised and hand rails and ladders changed to suit. The cost of remodeling the tank including the provision for an increase in capacity of 1,000 gal. is $1,600.

One of these tenders, after being out of the shop nearly two years, came in for general repairs, the entire cost of tender work being $40, most of which was caused by the application of a new pair of wheels. In other words, the maintenance on the tank itself for the first two years was negilgible. Even as the remodeled tenders get older, the cost of maintenance will unquestionably be but a small fraction of that of the old Vanderbilt type tenders. The entire conversion program wiil cost approximately $3,500 a tender, including labor, material and shop prorata, and this cost will be practically wiped out in a period of a little over four years.

Ten of the Vanderbilt tenders have been converted to date and the success of the new design has been such that it is being considered for application to new power.

A study of locomotive whistles

The whistle should be located in front and placed in a modified parabolic reflector

By Arthur L. Foley

Head of department of physics, Indiana University, Bloomington, Ind.

ABOUT five years ago the writer was employed by a railroad company to test the whistle, bell and headlight of one of the company's locomotives that had killed and injured a score of school children in a hack at a road crossing. The driver had obeyed the warning to "stop, look and listen." Apparently he had not seen or heard, although he had gotten out of the hack and walked to the center of the railroad track trying to do so. Why? I shall not try to answer this question in this specific case. It is the general case that most concerns us, for such accidents are quite common.

No doubt the crossing menace would be lessened somewhat, but it would not be removed, if by legislation or otherwise the public could be induced to stop, look and listen. Most crossing accidents involve motor cars. If the driver stops and sits in his car, his seeing may be prevented by buildings, corn fields, or other obstructions, and his hearing by motor noise, particularly in the case of the closed car. If the driver gets out of his car and walks to the center of the track and looks, he may even then, due to track curvature or adverse weather conditions, not be able to see an approaching locomotive as far away as would be necessary for safety. He may see the locomotive at a considerable distance and be deceived in thinking that he has plenty of time to cross the track before the train can reach the crossing. It should be remembered that a train running 60 miles per hour travels a third of a mile in 20 sec., the average time required for a driver to return to his car, take his seat and drive the car to the track. These facts, together with the obvious fact that nothing short of an army of police could bring about a general observance of the "STOP" part of the warning, emphasizes the importance of the "LISTEN" part of it. It is more important than the "LOOK," for the driver of a car who does not keep his eyes rather closely focused on the road he is driving over is more dangerous to traffic than is the locomotive whose path is fixed. But the driver may listen all the while, and may hear a locomotive which it would be impossible for him to see. It is timely, therefore, to consider the efficiency of locomotive whistles as danger signals, particularly since closed cars are coming into such general use. Such cars shut out a considerable fraction of the whistle sound and shut in much of that from the motor. The sound from the whistle must be sufficiently intense to be heard above, and of such a character as to be differentiated from, the hum of the car's motor and other mechanism. The locomotive whistle in common use signally fails to meet these requirements. It is rather strange that it has survived so long in this age of striving after efficiency.

Actual distribution of sound about a locomotive whistle—Ear estimates

The writer's first experiments on this question consisted in determining how far a certain locomotive whistle could be heard in various directions from the locomotive, when the listeners were in a closed automobile standing still with engine running, and again with engine stopped. Also when in a touring car under the same conditions. Ear estimates of the whistle intensity were made by each of five listeners when the automobile was stationed 1,200 ft. from the locomotive, in various directions, with the engine running and when the engine was stopped, on clear days and foggy days, and on days with various wind velocities. Finally, ear estimates were made of the relative intensities of the sound of the whistle at various distances ranging from 1,200 ft. to four miles, when the listeners were standing on the ground near an automobile with the engine running, and 20 ft. from the car with the engine running and when stopped.

The results of these and similar observations will not be given here, as they were confirmed by later quantitative experiments which will be discussed in some detail.

However, the writer has no apology to offer for mentioning such apparently crude observations. After all, it is the ear effect that the locomotive engineman must depend upon to save the lives of those crossing the railroad tracks, and the railroad company from damage suits. If the results of the ear estimates differed essentially from those made mechanically, I should discard the latter and base my conclusions on the former.

Quantitative measurement

In Fig. 1 is shown the respective radii of the 10 points (crosses) on the broken curve *A*, which indicate the relative sound intensities in the ten indicated directions from a chime whistle *W* on a locomotive *L* standing on a turntable on the track *T-T*. The intensities were measured with a Rayleigh disc. On the first day the observations were attempted a Webster phonometer was used to measure the sound intensity. On account of the extreme sensitiveness of this instrument to small changes of pitch, it was not satisfactory for the work in hand. It was, therefore, with little regret that the writer was forced to discontinue his experiments that day on the demand of some one to whom the noise of the whistle was objectionable.

Before undertaking the experiment a second time, the writer experimented on different forms of Rayleigh discs. The instrument in the form finally chosen was less sensitive than a tuned Webster phonometer, but had a much wider range through which the pitch of the sound might change without seriously affecting the instrument's sensitivity.

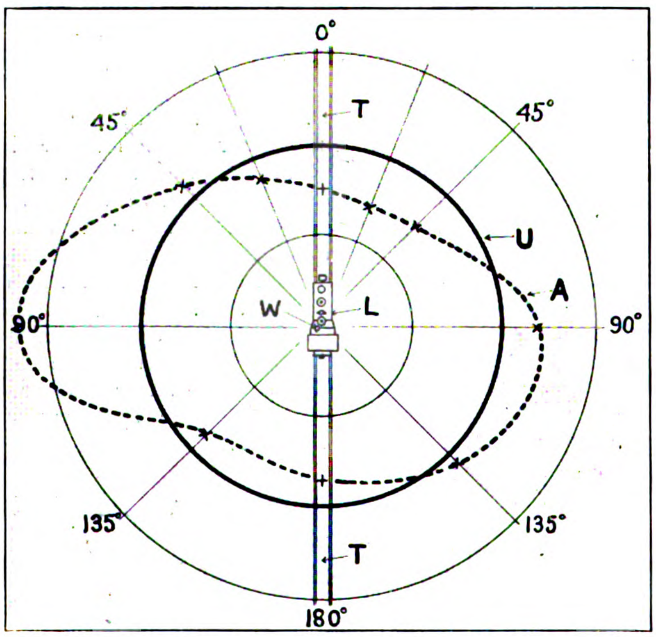


Fig. 1—Sound intensity, curve A, about a locomotive whistle mounted near the steam dome

The intensities shown in Fig. 1 were measured in the 10 directions shown, at a uniform distance of 1200 ft. from the whistle. Instead of moving the observing station the locomotive was placed on a turntable and the observing station located permanently at the side of the track 1200 ft. from the turntable. Then the locomotive was successively turned so that the relative direction of each of the 10 observing stations was that indicated by the respective numbered radii in Fig. 1.

Even had it been possible to move the Rayleigh disc and adjust it to the same sensitivity in all 10 positions, and had the time required been no consideration, the scheme of turning the locomotive had many advantages. It minimized, by making more nearly constant, the disturbing effects of winds, temperature changes and differences, the varying topography of the surrounding landscape, and reflections from houses, trees, and other objects.

The continuous curve *U* shows what the sound intensities in the several directions would have been if the sound of the whistle had been radiated uniformly in all directions. Note that the sound of the whistle, curve *A*, was actually more intense behind the locomotive than in front of it, and two or three times as intense at right angles to the track as along the track. In other words, most of the sound energy was dissipated at right angles to the track. Why this objectionable distribution?

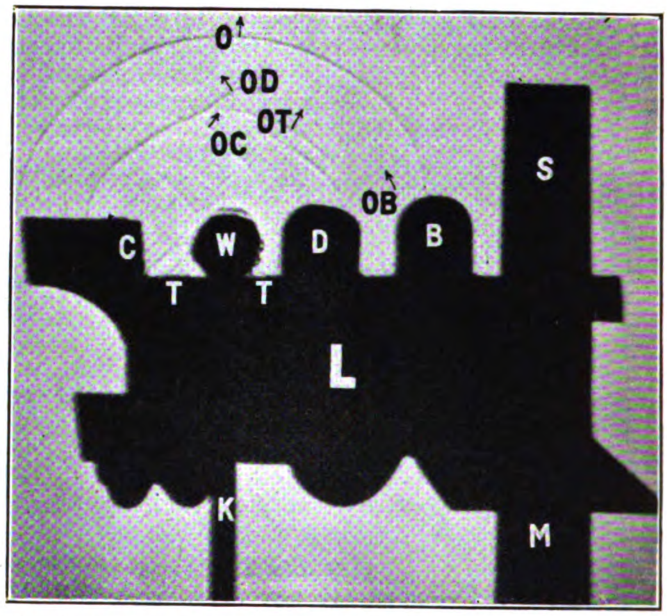


Fig. 2—Sound waves from an electric spark reflected from parts of a miniature locomotive

The general contour of curve *A* is about what one should expect from a whistle located as this one was, to the side of and rear of and only a few inches from, a steam dome several times as large as the whistle itself. Sound reflection from the steam dome and other parts of the locomotive and sound absorption by the hot gases issuing from the smoke stack and rising from the boiler explain the matter. Let us consider these effects separately.

Sound reflection

From the standpoint of sound reflection, also refraction and absorption, as we shall see later, the location of a locomotive whistle is bad, usually about as bad as if it were placed inside the cab or under the locomotive itself. It is always behind the stack, usually behind one or more domes and the bell, and frequently immediately behind or at the side of pop valves or other accessories mounted on the top of the boiler. All of us know that if we wish to shout to some one at a considerable distance that we turn toward the listener so that the sound will be projected initially in that direction. All of us know that we can be heard at a greater distance if we do not stand behind a lamp post or a tree when we shout. Nevertheless, we continue to locate whistles from the standpoint of convenience only, with no thought of a possible connection between the whistle's location and its efficiency in doing the only thing it is expected to do; namely, to make as much noise as possible in front of the locomotive

and as little as possible where it is not only not needed, but is usually a nuisance.

When the whistle is placed behind the smoke stack, dome, etc., all these objects reflect the energy of the portion of the sound wave that falls upon them. Since a sound wave has been long compared with a light wave, the sound shadows thus produced are not comparable in density or definiteness to the light shadows that would result were the whistle replaced by the headlight. Nevertheless, there are sound shadows of more or less intensity, depending on the size of the object casting them and on its distance from the sound source. In other words, depending on the solid angle of the object as seen from the sound source. Where the distance is small and the angle large, as when a whistle is mounted very near a dome or a pop valve, immediately behind or at one side in some recent practice, the intensity of the sound ahead of the locomotive is decreased and at the side or rear increased over what it would be were the whistle mounted in front of the smoke stack. This is clearly shown in curve *A* of Fig. 1, and is illustrated in Figs. 2 and 3.

If the reader's imagination is sufficiently strong, perhaps he may think of *L* in Figs. 2 and 3 as a crude miniature locomotive with exaggerated dimensions of some of the parts. The smoke stack *S* was the upper end of a metal tube *M* about two feet long, which served also to support the model. *C* is the cab, *D* the steam dome, *B* the sand box and *T-T* the top of the boiler. The whistle *W* consisted of a spark gap behind a disc of insulating fibre, the gap being about ¾ in. long and connected through conductors *K* to an electric influence machine. The crack of the electric spark produced the sound waves shown in the figures. These waves were photographed by a method described by the author in the November, 1912 Physical Review and also in the Scientific American supplement of February 15, 1913.

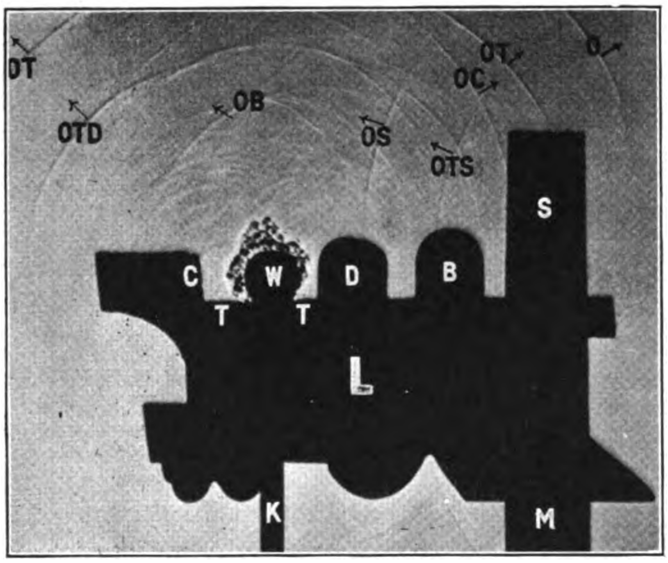


Fig. 3—Sound waves from an electric spark, showing sound waves of greater radius than those shown in the preceding figure

In Fig. 2, *O* is the original sound wave produced by the spark at *W*. If the wave had encountered no obstructions it would have traveled outward from *W* uniformly in all directions, as in Fig. 4. We note, however, that there have been many reflections. *O B* is the reflection of *O* from *B* "caught in the very act." *O T* is the reflection of *O* from the top of the boiler *T*, *O D* from the steam dome *D* and *O C* from the cab *C*.

It is interesting to trace the further development of these waves, as shown in Fig. 3, a photograph taken about .0001 sec. later than the photograph in Fig. 2. The same lettering is used in both figures, the arrows indicating the direction of the waves. In Fig. 3 the original wave has passed out of the field on the left of the picture and shows only at *O* at the upper right hand of the photograph. *O S* is a reflection of *O* from the stack *S*. Note that *O T* in Fig. 2 has expanded, struck the stack *S*, and given us the wave *O T S* in Fig. 3. *O C* of Fig. 2 has just arrived at the stack in Fig. 3.

It is not necessary to trace all the waves that have been formed. It is sufficient that we see that, owing to numerous reflections, the space above the model locomotive is filled with waves, that most of the sound energy is headed upward, and that there is not enough in front of the locomotive to show in the picture.

Owing to the shortness of the spark waves and the exaggerated dimensions of some of the parts of the miniature locomotive, Figs. 2 and 3 exaggerate the magnitude of the effects of reflection. They do, however, quite accurately represent their nature.

Sound refraction and absorption

The very undesirable sound distribution shown in curve *A* of Fig. 1 would be much worse in the case of a locomotive running at high speed. A locomotive standing on a turntable requires very little firing to keep up the steam required to operate the whistle. There is little smoke from the stack, and what there is rises some distance before deviating much from a cylindrical form. It is very different when a locomotive is moving rapidly. When running the exhaust steam is blown through the stack to increase the draft, causing smoke and hot gases to be ejected in large volumes. These, together with the convection currents from the hot boiler, are swept back over the locomotive, forming a sort of gas, steam and smoke blanket through which the sound of the whistle must pass.

It is a well-known fact that a part of the energy of a sound wave is reflected when it falls upon a stream of hot gases; some is absorbed in the stream itself and that which gets through is dispersed. The loss due to absorption and dispersion is much greater than one might imagine. If anyone doubts this statement let him stand on one side of a bonfire and try to talk to some one on the other side. He may fail to make himself heard at all.

A striking illustration of the blanketing effect of air currents and air strata of different temperatures is observed in the variation of the intensity of the sound of the exhaust of an aeroplane engine as it passes over. Sometimes the roar of the engine is quite loud, sometimes it is weak, perhaps inaudible. The shifting air currents and the changing path that the sound must take to reach the ear from a moving plane cause the intensity variations.

The intensity of sound in the shadow of a stream of hot gases is generally much less than it would be were the gas stream replaced by a solid obstacle of the same size. This point is illustrated in Fig. 4, which is a photograph of sound waves passing through or around cylinders of hot gases and metals. *W S* is a sound wave produced by an electric spark, perpendicular to the plane of the figure, behind the disc *S*, and *W G* a wave produced by a like spark behind the disc *G*. The sparks were made to occur simultaneously by connecting the two spark gaps in series. The waves *W S* and *W G* are consequently of the same size and intensity. *C* is a metal cylinder one inch long, of the same length as each of the spark gaps. When a spark passes at the gaps *S* and *G* there is a sudden heating of the air between the terminals of the gaps, producing at each one an expanding mass of hot air of

approximately cylindrical cross section. By properly adjusting the distances between *S*, *G* and *C* and by carefully timing the illuminating spark by which the photograph was taken, the waves were photographed in the positions shown in the figure.

Inspection of Fig. 4 shows that in passing the solid cylinder *C*, the portion of the wave *W G* which struck the cylinder was reflected to *W C*. The portion passing just above and just below the cylinder was being diffracted into the region *R* in the general direction shown by the arrows *D*, *D*. The solid cylinder did not, therefore, cast a definite sound shadow, though the sound intensity in *R*, the sound shadow region, was less than it would have been if *C* had not reflected some of the sound energy.

Note the difference in the region *A*, which is the sound shadow region behind the hot gases produced by the electric spark at *S*. Apparently all of the sound energy that entered the hot air cylinder near its central and therefore thicker and hotter parts was absorbed. Only those parts of the wave entering the upper and lower edges of the cylinder where the gas was not so hot and the distance to be traversed not so great was transmitted. Owing to the fact that the velocity of sound increases with the temperature these transmitted portions of the wave were refracted in the direction of the arrows *T*, *T*, the edges of the hot air cylinder thus functioning like a dispersing lens. Consequently the intensity of sound in region *A* was less than in region *R*, the hot air cylinder casting a deeper sound shadow than a solid body of the same size. It appears, therefore, that the disturbing effect of the high smoke stack of Figs. 2 and 3 would have

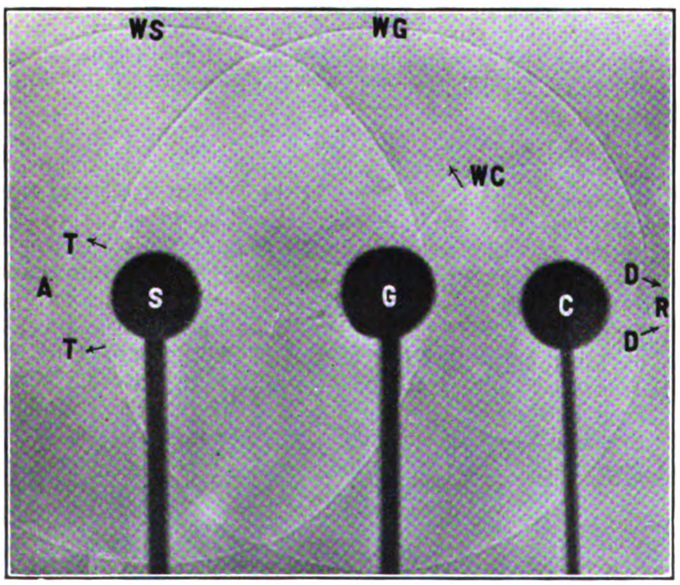


Fig. 4—Sound waves due to simultaneous electric sparks at G and S, showing diffraction about a solid cylinder C, and dispersion of the hot gas cylinder at S

been even greater had the stack been low, with hot gases issuing from it. And had the gases been blown back over the locomotive, the effect would have been even more disturbing.

A suggestion of the magnitude of the effect may be gained by comparing Fig. 3 with Fig. 5. In the latter a small bunsen burner was so placed that the tip of the flame was in the lower end of a brass tube, the upper end of which formed the smoke stack *S* of the miniature locomotive *L*. The hot gases issuing from the stack were blown back over the locomotive by means of an air jet in the direction of the arrow *A*. Observe that the original sound wave *O* is about the only one that shows in Fig. 5 and this only over the rear half of the locomotive. There is no trace of a wave near the stack, where the gases are hottest. The wave has not been hidden by smoke. What one sees in the picture is not the photograph of smoke at all. The air inlet on the gas burner had been adjusted so that the gas burned with a smokeless flame. One does not see smoke when he sees the heat, really the convection currents, rising from the hot radiator of his automobile. However, hot gases may be quite transparent to light and not transmit sound.

If the disturbing effect of hot gases and heat currents

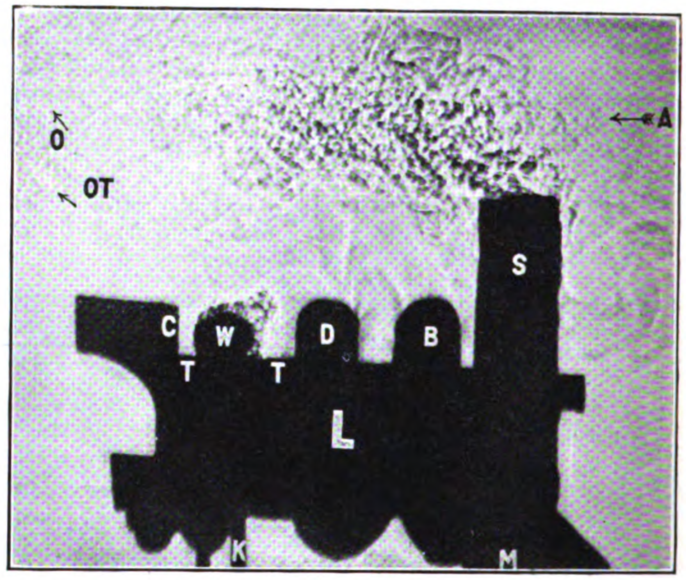


Fig. 5—Absorption of sound energy by the hot gases from the smoke stack of a miniature locomotive

were the only reason for locating a locomotive whistle ahead of the smoke stack it would be a sufficient one. It is noted that the sound was weaker both in front of and to the rear of the locomotive than it would have been had the sound distribution been uniform, while at right angles to the track, particularly on the left side of the locomotive, the intensity was much greater than with uniform distribution.

Another factor which had to do with the sound distribution shown in Fig. 6, is the design of the whistle itself. The usual cylindrical tube forming the resonator (bell) of a single tone whistle is, in the case of the chime whistle used in this study, divided by longitudinal radial vanes into five compartments or pipes, each of the proper length to give one of the notes of the chime; namely, *C*, *E*, *G*, *C′* and *C″*. *T* in Fig. 6 is a transverse section of the whistle and *L* a longitudinal section, with the omission of the valve mechanism at *V*. The former shows the relative positions and cross sectional areas of the five pipes while the longitudinal section shows the relative lengths of two of the pipes *C* and its octave *C′*. The fraction of the cylindrical steam jet *J* used in blowing each of the pipes is shown in the transverse section *T*, and was 26 per cent in the case of the lower tone *C* and respectively 22, 19, 17, and 16 per cent for the other four tones. Thus 60 per cent more energy was used in blowing the lower tone than in blowing the upper tone of this whistle.

Since the quality or character of a sound depends on the relative intensity of the several tones which combine to form it, it is evident that the quality of the sound from a chime whistle depends to a degree upon which pipe of the whistle is toward the observer. This variation with direction is accentuated when the whistle is

placed near a steam dome, which interferes more or less with the normal functioning of that part of the whistle which happens to be nearest it. Inasmuch as the Rayleigh disc was not equally sensitive to all five tones of the chime, intensity measurements made with the disc showed considerable variation whenever there was a change in the orientation of the whistle with respect to the dome.

The writer would locate a locomotive whistle in front of the locomotive where it would be free from the several disturbing factors named. He would place it in a reflector of such design as to give a maximum of sound intensity ahead of the locomotive and of such size as to serve as a resonator and thus increase the intensity of the sound at the source.

In advocating the use of a reflector to direct the sound of the whistle along the track the writer has continually met with the argument that such a device would be practically useless on account of the fact that the reflector could not be made large compared to the length of the sound waves to be reflected. This limitation does, of course, affect profoundly the rate at which sound wave energy spreads out after the waves are outside the reflector. But it does not change the action of the reflector itself. The energy of the reflected portion of the sound wave can be headed in the right direction, and much of it will continue in the right direction to reinforce the wave originally projected in that direction. In proof of this assertion it is sufficient to call attention to the effectiveness of a megaphone as a sound director. We should expect a relatively greater directive action from a reflector placed about a whistle. In the case of the voice the waves are originally projected in one hemisphere only, the whistle starts them in both hemispheres. The whistle reflector reflects a portion of the waves in the one hemisphere, as does the megaphone; but in addition it turns back those that start in the other hemisphere.

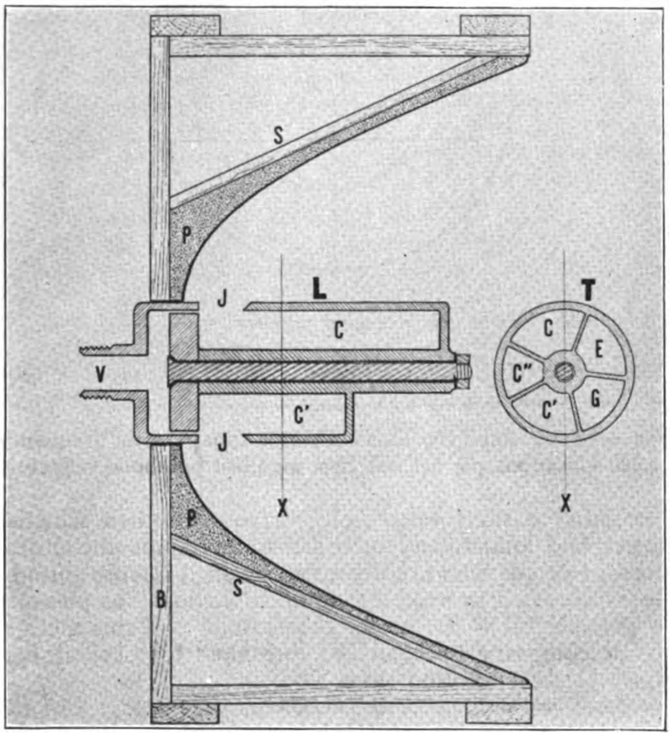


Fig. 6—Transverse and longitudinal sections of a chime whistle modified parabolic reflector

It is strange that the belief that sound can not be reflected by anything except a very large body is so persistent and so general. A person who voices this belief is quite inconsistent when he places his hand to his ear in order to hear a speaker not easily understood with the unaided ear. Even a mule knows that sound can be reflected. He turns his ears in the direction from which the sound comes. It must be admitted that the ears are not as small as they might be, but they are not as long as the sound waves the mule must interpret.

To determine whether or not a reflector of moderate size could be made to exert any considerable directive force on the sound from a locomotive whistle, the chime whistle previously described in this paper was placed in a parabolic reflector, as shown in cross section in Fig. 6 in which all dimensions are to the same scale. The whistle was 6.5 in. in diameter and the aperture of the reflector 28 in. The reflector was made of plaster paris *P* cast in a wooden box *B*. Wooden strips *S* were nailed in the box in the manner indicated in the drawing to economize on plaster and lessen the weight. The box was mounted on castors so that it could be turned on a platform about six feet in diameter and eight feet high. The steam line projected vertically through a hole in the center of the platform and was connected with a union joint to the valve end *V* of the whistle. This permitted the reflector and whistle to be rotated so that their common axis was in any desired horizontal direction.

The shape of the plaster paris surface of the reflector was obtained as follows: with a focal point on one edge of a board and the edge, the axis of a parabola, a curve was drawn on the board and the half parabola sawed out. With the board radial and its straight edge held against the whistle the board was moved around the whistle and the soft plaster paris "wiped" into position. The focus of such a reflector, if the term focus is permissible, is therefore a circle, and not a point. The focus of any particular portion of the parabolic surface is the nearest point on the focal circle. This focal circle was intended to be coincident with the cylindrical sound source—the cylindrical steam jet, at *J-J*. The length of the steam jet, the distance from the opening to the lip, was two inches. There is a question as to what portion of the jet should be used, or whether some point beyond the lip should be used, as a focal point in adjusting the whistle in the reflector. Experiments were made with the whistle in one position only, quite likely not the position to give the reflector the highest possible efficiency. Nevertheless, the action of the reflector was quite marked.

The curve in Fig. 7 gives the relative intensity of the sound in the 12 directions indicated by the radial lines. The dissymmetry of the curve with respect to the axis in direction one is doubtless due to the fact shown in the figure that the whistle was so placed in the reflector that the lower pitched and louder tone was produced on the side of the axis toward direction two, while the higher and less intense tone was produced on the other side of the axis, in direction 12. Notwithstanding the dissymmetry the curve clearly shows a sound intensity in the direction of the axis of the reflector double that at right angles to the axis and three times that to the rear.

Comparing the result shown in Fig. 7 with that shown in Fig. 1, it is seen that, by placing a locomotive whistle in a reflector in front of the smoke stack the intensity of sound along the track in front of the locomotive was increased to four times its value when the same whistle was located in the position *W* shown in Fig. 1. In direction two the intensity was five times as great. At the same time the intensity at right angles to the locomotive was correspondingly decreased. The maximum intensity could have been changed from direction two to one by rotating the whistle in the reflector.

No doubt the multiplying factor could have been fur-

ther increased had the reflector been made of a material having a higher sound reflection co-efficient that plaster paris.

The placing of a locomotive whistle inside a reflector with its longitudinal axis parallel to the axis of the reflector has advantages other than those already noted. One is, that all parts of the circular steam jet function, which is not the case when the whistle is mounted vertically and the locomotive is running at high speed. This point was investigated by placing a locomotive chime whistle in the usual vertical positon in a horizontal stream of air from a compressor capable of delivering 4,000 cu. ft. of air per minute at a pressure of 100 lb. to the square inch. The stream of air was adjusted to give air velocities at the whistle of 20, 40, and 60 m. p. h. Very little effect was noticed at 20 m.p.h. At 40 m.p.h. the front portion of the whistle, the part against which the air current was directed, functioned rather poorly, the volume of the sound being considerably less than at 20 m.p.h. At 60 m.p.h. it did not function at all, nothing but the hissing sound of escaping steam coming from this portion of the whistle. As the whistle was rotated the character or quality of the sound changed noticeably as one after another of the several tones of the chime was silenced. The steam jet whose vibrations about the lip of the whistle produce the sound, must strike that lip in a particular way to give the best result. When a locomotive is running at high speed the head on pressure and the air currents about the sides of the whistle deflect the steam jet

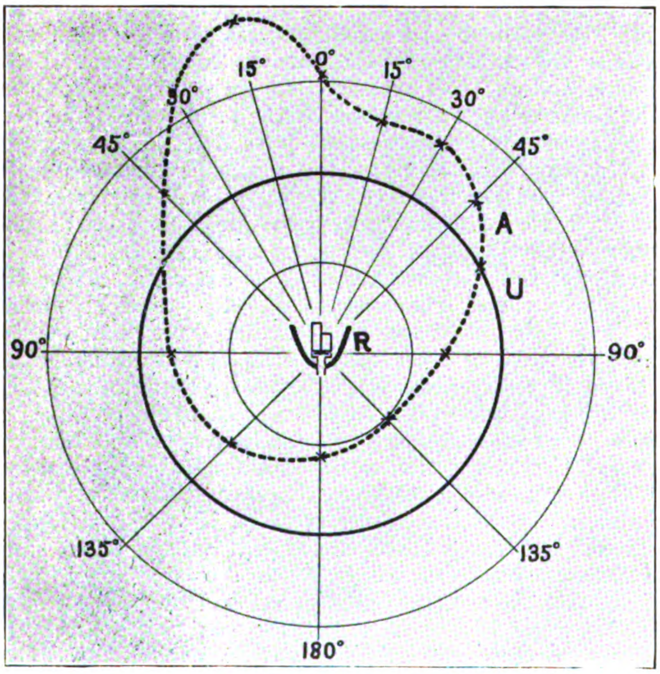


Fig. 7—Sound intensity about a chime whistle mounted in a modified parabolic reflector

so that some portions of it function poorly and others not at all.

The writer remembers a case in court in which a railroad company was being sued for damages because of a crossing accident. Some of the witnesses testified that the engineer sounded the whistle for the crossing and that "it fairly screeched." A "screeching" sound is what one would expect from a vertically mounted chime whistle on a locomotive traveling at a high speed. Let us remember that a wind having a velocity of 60 m.p.h. is normally classed as a tornado. The whistle may fail to function properly at much lower locomotive velocities if the train is running against a head wind. Thus the whistle is least efficient when the train is running fastest and the warning signal is most needed.

In the case of a whistle mounted in a reflector, as in Fig. 6, the body of air about it is carried along with it and the air pressure remains uniform on all sides of the steam jet, regardless of engine speeds or wind velocities. This permits the whistle to function normally at all speeds.

It would seem that locomotive manufacturers have attacked the problem of the inefficiency of locomotive whistles from one standpoint only—that of the intensity of

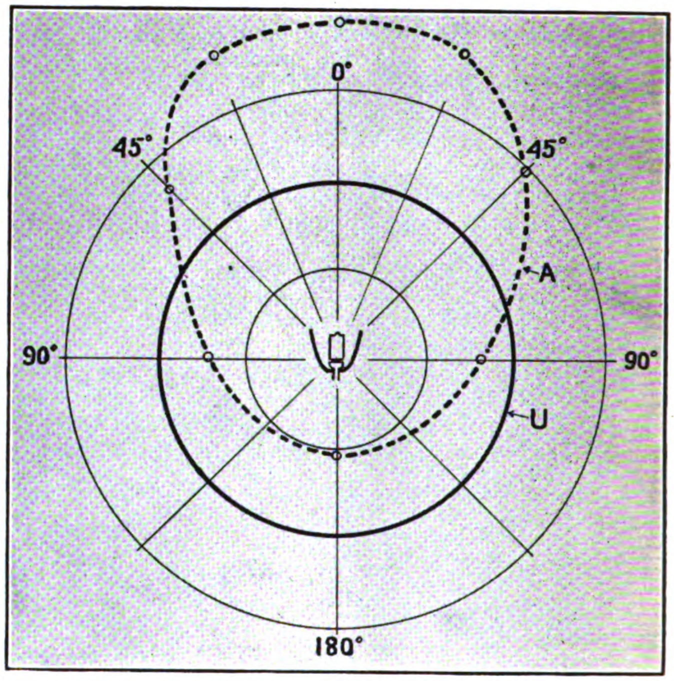


Fig. 8—Sound intensity about a single tone whistle, frequency 1,000 vibrations per second, in a modified parabolic reflector

the sound at the source. They have made their whistles larger and louder, and in order to overcome the objections of people who are disturbed by such intense sounds, they have tried to make the sounds "mellow," as pleasing as possible. It is the writer's contention that this method of attacking the problem is a mistake—for several reasons. I shall mention three of them.

First, we should consider the efficiency of the sound as a warning signal a quarter of a mile, a half mile, in front of the locomotive. We should consider the one to be warned, and not merely the sound source. If the effort to make the sound of the whistle "mellow" and pleasing results in a less efficient signal and consequently in greater destruction of life and property, it is a mistake.

In the second place the increase in the sound intensity of locomotive whistles has necessitated an increase in their size and a consequent lowering of their pitch, a move in the wrong direction. All the information that the writer has been able to get from several psychologists and from his own experiments is to the effect that the human ear is more sensitive to sounds of from 1000 to 1200 vibrations per second than to those of lower frequency. The pitch of the usual locomotive whistle is from one to two octaves too low for efficient signaling.

Another advantage of the higher over the lower pitch is that the former is much more likely to attract attention on account of the sound being unlike the hum of automobile engines and gears, and other usual sounds.

In the third place it would seem that the cost of whistle blowing is an item that has been given little attention.

We have increased the size of whistles with little or no regard to the resulting increase in their operating cost. If this increase had brought about greater whistle efficiency, it would be justified. The expected result has not been realized. A little consideration will convince one that we "pay dearly for the whistle."

According to the company that manufactured it, the chime whistle used in this investigation—a regular locomotive whistle—requires about 8,352 lb. of steam per hour when blown at 200 lb. steam pressure. Locomotive manufacturers say that seven pounds of steam per pound of coal is good average locomotive practice. This means a coal consumption of 1,190 lb. of coal per hour, more than 19 lb. per minute, approximately one pound of coal for every three seconds, or two pounds for every time the whistle is blown—the series of blasts for any signal aggregating, on the average, about six seconds.

The writer by means of a counter and stop watch made several estimates of the time whistles are blown. Observations were made on six different trains on four different roads, in Indiana and Illinois, the trips ranging from 50 to 220 miles in length. Considerable variation was found for different engine crews and for different roads. The average ran something over two minutes per hour. Assuming this figure, a locomotive equipped with the whistle described and operated at the indicated pressure requires some 39 lb. of coal and 275 lb. of water per hour for whistling purposes only.

There are in use on a 24 hour day basis, some 66,000 locomotives, and on the average one-third of these are in continuous use. To blow these whistles on an average of two minutes per hour would require the enormous total of almost 4,000,000 tons of coal and more than 26,000,000 tons of water per year. Why incur this enormous expense if a small high pitch whistle is more efficient and at the same time more economical in operation?

Curve *A* of Fig. 8 represents the sound distribution about a small whistle of the pitch recommended—frequency 1000 vibrations per second. This whistle was mounted in a tin reflector, the relative dimensions of the two being about those shown in the figure. For testing the resonance of the reflector its depth was changed three times by soldering an additional strip of tin an inch wide around the edge. Sound intensity observations were made with each depth. The resonance effect, while appreciable, was not great. It was sufficiently large, however, to warrant taking it into consideration in designing a locomotive whistle sound reflector. It will be observed that the total area of curve *A*, which is proportional to the total sound emission when the whistle was in a reflector, is greater than that of curve *U*, the emission when the whistle was vertical and without the reflector. The effect of the reflector, therefore, is not only to modify the distribution of the sound but to increase its intensity at the source.

The steam required to blow the high pitch whistle whose sound intensity curve is shown in Fig. 8 was 2,500 lb. per hour as against 8,352 lb. for the chime whistle of Fig. 1. This means a saving of 70 per cent of the coal required for whistling purposes, which on the basis of our previous estimate, would amount to some 2,800,000 tons in the United States alone. This is worth considering, not merely from the standpoint of a railroad expense item, but from the standpoint of fuel conservation.

A question that has been raised in connection with whistles of high pitch concerns the carrying power of high pitch sounds. This question is important when considering marine fog signals and steamship whistles, but of little import when designing locomotive whistles. The distance through which the sound of a locomotive whistle must pass is so limited that the difference in the atmospheric absorption of the lower and higher pitched tones may be ignored.

Whistles of the higher pitch are used almost exclusively on the locomotives of England and other foreign countries.

An objection that has been urged against the use of a reflector on a locomotive whistle is that the whistle could not be used to signal to the rear of the train—to recall a flagman, for instance. This objection is not serious. Note, Fig. 8, that the sound intensity in the rear of a locomotive is a little more than half of what it would be if the whistle were vertical and without a reflector. It should be more than sufficient to signal the flagman. It should be remembered that the flagman is listening for the whistle; he is not in a closed car, nor is he disturbed by automobile or other noises.

If it were desirable to increase still further the per cent of sound energy reflected in a forward direction it could be done without destroying the resonance of the reflector by approximately doubling its length. If then the sound in the rear proved to be insufficient for signaling purposes, a second whistle could be mounted so as to face the rear, just as two headlights are sometimes used.

It is a matter of common observation that locomotive whistles on different roads, and frequently on the same road, differ greatly in pitch and in quality. When one hears a whistle, frequently he cannot tell whether it is a locomotive whistle or a factory whistle. He becomes so accustomed to hearing such sounds, that they may call forth no mental reaction whatever. If all locomotive and traction car whistles were of one pitch and others were prohibited from using whistles of that or near that pitch, the human ear would soon come to recognize that tone and instinctively associate it with danger. Not only this, but the volume of sound required to produce a mental stimulus would be greatly lessened.

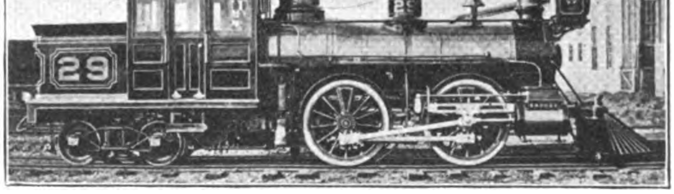
The writer advocates a legal standard pitch for all locomotives and traction car whistles, and legislation that will guarantee railway companies its exclusive use.

Conclusions

Stated very briefly the writer's conclusions are as follows:

1. Locomotive whistles, like the headlights, should be located in front.
2. They should be placed longitudinally in modified parabolic reflectors.
3. The dimensions of the reflectors should be such as to make them resonant.
4. The whistles should be of a frequency of about one thousand vibrations per second.
5. All railway whistles should be of the same pitch, no others being permitted to use a whistle within a half octave of the railway standard.

The writer wishes to acknowledge his indebtedness to H. R. Kurrie, president; J. T. Strubel, master mechanic, and Joe Little, Bloomington yard foreman, Chicago, Indianapolis & Louisville, for their interest in this study and for the railroad equipment placed at his disposal.



An old time tank locomotive of the seventies

Development of foremen

"FROM the comments of 90 separate companies that have had experience in foreman training, 83 express favorable results in no uncertain terms, five express doubtful value and most of these give what they consider to be the reasons therefor, while only two report no success whatever." This statement occurs in the preface of a study on "Foremanship—Fundamentals in the Development of Industrial Foremen"* which is the first of an "Industrial Relations Series" of studies which is being prepared by the Department of Manufacture of the Chamber of Commerce of the United States. Later there appears in the report the significant statement that, "Experience has proven that where the management supported foreman training half-heartedly, even the best methods have failed."

Recent months have witnessed a great demand on the part of railroad officers and foremen for exact information as to just how best to promote foreman training. This survey goes into the entire subject in considerable detail and will be found equally valuable for either the industrial or railroad field, since it deals with methods and practices, rather than details of the contents of the training courses. Some idea of the scope of the report may be gathered from the chapter headings which follow: Word "Foreman" Defined; Purpose of Foreman Training; Beginning Foreman Training; Sources of Instruction; Who Should Direct the Cource; Content of Course; Methods of Instruction; When Should Meetings Be Held; Where Should Course Be Held; Personnel of the Group; Number, Frequency and Length of Meetings; Follow-up; What Does Foreman Training Cost; Sub-Foremen to Foremen; and, What Some Companies Say About Foreman Training. An appendix contains the addresses of state universities which offer foreman training extension courses, as well as the addresses of state departments of education or vocational education, which provide for foreman training under the Smith-Hughes Act.

In the chapter or section on "Beginning Foreman Training," the suggestion is made that some prefer to use such terms as foremanship, foreman conferences or foreman development, rather than foreman training, "on account of the psychological effect of the word training on mature people." This suggestion is well taken in the railway field, because while it is imperative that workers be adequately trained and prepared for promotion to the position of foreman, those who now hold such positions frankly admit the need for help and guidance; indeed, they have in most cases initiated the movement toward that end and have of their own accord organized what is commonly designated as foremen clubs or associations. This chapter includes also rather complete information as to how a large company—the Westinghouse Electric & Manufacturing Company—and a medium sized one—the Corning Glass Works—started their plans for the foremen's development.

In discussing sources of instruction attention is given to sources within the organization and also Y. M. C. A.'s, private educational institutions, federal and state vocational departments, state university extension courses, and other organizations, such as manufacturers' associations, chambers of commerce, etc.

It is important to keep in mind that completion of a course of study in foremanship is little more than the beginning or scratching of the surface. To be really effective, these courses must be followed up in such a way that the foreman will be inspired to keep in touch with the latest developments and to continue his reading and studies along the right lines. Unfortunately the necessity and importance of following up foremanship courses has been recognized to only a very slight extent. One of the most important sections of the Chamber of Commerce report is concerned with a discussion of plans for following up intensive courses or conferences on foremanship. In some cases foreman's clubs or associations are formed and the report gives a typical constitution for such an organization, together with a list of 124 typical topics for papers and discussion at foreman training meetings.

The compiler of this report is indeed to be congratulated for bringing together in so small a compass so much practical and useful information, which is being eagerly sought at this time, not alone by the industries, but by the railroads and public utility organizations of this country as well.

* Copies of this 48-page, 6-in. by 9-in. pamphlet may be obtained from E. W. McCullough, manager, Department of Manufacture, Chamber of Commerce of the United States of America, Washington, D. C. Initial copies will be supplied without charge, but a charge of 10 cents each—the bare cost—will be made for additional copies.

A suggestion for firing locomotives *

By R. W. Karns

Engineer, Cincinnati Division, Pennsylvania, Columbus, Ohio

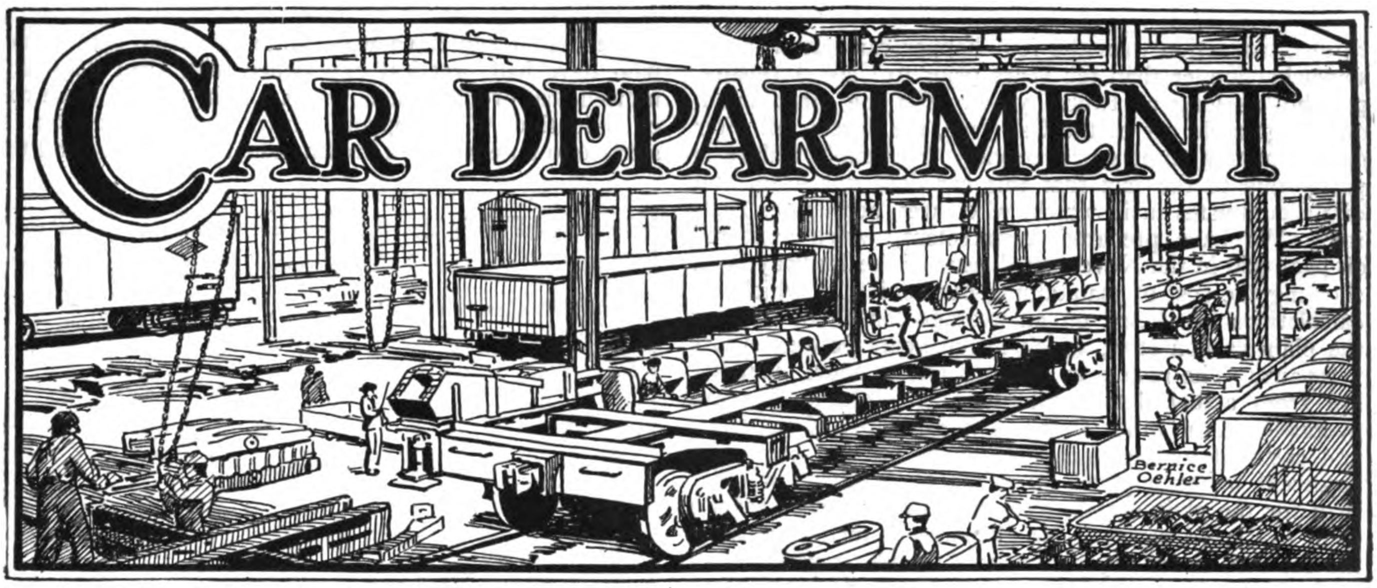
THE proper and what I think the most economical method of firing a locomotive has just been recently demonstrated to us. This system calls for a bank around the door and in both back corners of the firebox, extending forward about 15 or 18 inches. The fire beyond this bank is level and thin. As it requires more pounds of air than coal to manufacture steam, this method permits air in sufficient quantities to pass through the fire, insuring perfect combustion or as nearly perfect as can be had on a locomotive. The engine being drafted so that by maintaining this bank at the door, throwing very little ahead, using three and four shovels of coal at a fire, the draft, so to speak, will pull it ahead as it is needed. This practice lessens the work of the fireman.

This system, in addition to eliminating most of the smoke, insures a uniform steam pressure, and when a uniform steam pressure is maintained the engine can be worked to a greater advantage, the injectors can be better regulated, the superheater will better perform the service for which it is intended, which all means less coal. Care should be exercised at all times to prevent the safety valve raising as this is very wasteful and indicates that the fireman is not watching the steam gage.

In carrying out this system on our run, which is a six to eight car train in one direction and 10 to 12 cars in the other, we are actually doing the job on one-third less coal than the old system and find it much easier for the crew.

The saving of fuel is a big question and simply means co-operation on the part of all concerned. The engineer and fireman must see their work as a partnership affair, work together, keep the question of fuel before them at all times. This is our duty and when we get this spirit into our work, we will have cleaner and more pleasant runs, the service will be better, with less complaint and, most of all, the fuel consumption will be cut considerably.

*Abstract of the prize winning paper on fuel economy submitted in a contest open to engineers and firemen on the Western region of the Pennsylvania.



Rustproofing of steel materials*

Copper bearing sheet steel for cars resists corrosion—Methods of and economies effected by baking paint on passenger and freight cars—Painting with lacquer

By Dr. M. E. McDonnell
Chief chemist, Pennsylvania System, Altoona, Pa.

ENGINEERS now know that commercial steel on the market varies greatly in its tendency to rust. We have made many tests for the purpose of developing resistance to corrosion. On August 1, 1912, 15 weighed commercial steel sheets were exposed to the weather and on February 13, 1913, after six and one-half months exposure, they were wire brushed and re-weighed. It was found that the rate of rusting varied much, the minimum loss being 30.12 grains and the maximum loss 84 grains on the two sides of a square foot of surface. The results are shown in the curve in one of the illustrations and it is to be especially noted that the sheets showing the lowest losses in weight, contained copper. The curve on the plot shows the copper content. This heretofore unpublished chart was prepared in 1915, and it was largely instrumental in bringing about the decision of the Pennsylvania management to adopt copper bearing steel for car roofs.

Additional tests were made of a lot of 258, 16-gage and 230, 22-gage sheets of plain carbon and copper bearing steel which were placed in test racks and exposed to the elements. After 16 months of exposure 30, 22-gage plain carbon sheets failed while no copper bearing sheets failed. After 28 months exposure, the number of 22-gage plain carbon failures had increased to 77 during the same period only six 22-gage copper bearing sheets had failed. Some of the panels had entirely turned to rust. After 75 months exposure every plain carbon steel sheet had failed, while 13 copper bearing 22-gage sheets were free from holes or ragged edges. Also, at the end of that period, 102 of the 126, 16-gage plain carbon steel sheets had failed, while there was not a single failure among the 132, 16-gage copper bearing steel sheets. The average life of the copper bearing 22-gage sheets on this test was over 49 months, while the average life of the 84 plain carbon steel sheets was 23 months.

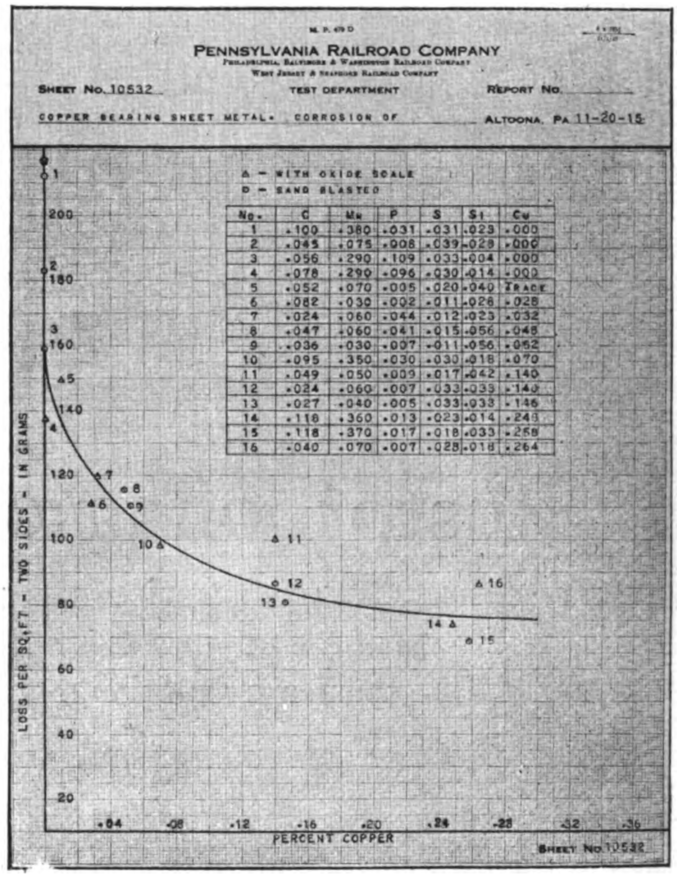
The Pennsylvania System has some 269,000 freight cars, of which 266,588 are of steel construction, 167,398 of these being steel throughout. These steel cars are of different weight and design. There are approximately 32,000 all steel box cars, on which the rate of depreciation due to rust is not yet definitely known. They can be protected against rust by means of paint coatings to a much greater extent than an open car which is used for rough freight, and the roof protects the inner side of the plates. No attempt will therefore be made to estimate the value of copper bearing steel for this class of cars.

There are 135,523 open all-steel freight cars on which much maintenance data is available. After they have been in service for a number of years, the sheets become thin and holes develop. When they have reached this condition, it is possible to patch the failed sheets, but if this is done, the surrounding sheets are likely to fail and the cost of this kind of maintenance is likely to become excessive. When failure of sheets begins to occur due to rust, it is better to apply Class 1 repairs, which involves cutting all rivets, removing sheets, and rebuilding the car body. The age of the car at which this class of repairs is called for varies some, depending on design and service. The standard four-hopper coal car designated H21a now required this attention after ten years of service. The two-hopper coal cars of the G1 type is of slightly more

*Abstract of paper presented before the regional meeting of the American Society of Mechanical Engineers, held at Altoona, Pa., October 5, 6 and 7, 1925.

rigid construction than the four-hopper car. It will run somewhat longer than ten years prior to Class 1 repairs, possibly as long as twelve years. On the other hand, on the gondola car of the Gsd type, the sheets fail after approximately eight years' service. This rapid failure is partly due to the fact that this car does not drain and dirt accumulates in it, which, when wet, accelerates rusting. We have prepared a statement, which appeared on page 850 in the November 7 issue of the Railway Age, showing the cost of maintaining car bodies, in which the calculations are based on an average length of life for the plain carbon steel, which is ten years between Class 1 repairs. The results in columns one to four, inclusive, are from actual data, while those in column five are averages of the other four. The estimates of materials and costs of maintenance for copper bearing steel cars represent an anticipated 50 per cent greater durability than for the plain carbon steel cars, or a 15 year service prior to Class 1 repairs. No allowance is made for painting the cars or for any repairs to the underframes, trucks or brake equipment. The increased cost of cars due to the use of copper bearing steel is shown. This is obtained by applying the differential of $3.00 per ton which has prevailed between plain carbon and copper bearing steel plates. This amount may diminish when the amount of copper bearing scrap now being used by the steel makers is increased. In making the calculation, allowance is made for losses in fabrication caused by shearing and punching. It is shown that the 135,523 cars involved would have cost $2,509,295.86 more if they had been made of copper bearing steel. The statement shows the amount of new finished plates, shapes and rivets, as well as the cost of material and labor, including shop expenses, required to dismantle and rebuild car bodies. If these cars are given Class 1 repairs over a period of ten years, using plain carbon steel sheets, the annual cost under present market conditions amounts to approximately $5,069,112.04. From the experimental data at hand to date, it may be assumed that with the use of copper bearing steel, the interval between Class 1 repairs will be extended over a 15-year period and repairing with copper bearing steel sheets reduces this cost to approximately $3,473,710.30. This represents an annual saving of $1,595,401.73 and an annual reduction of 22,385 tons in the amount of new steel required.

Those who have not given this subject special study may wonder why copper is a protective measure and what connection it can have with protective coatings. Those who have had practical experience with steel may have noticed that ordinary steel forms a light brown, loose rust on oxidation, while copper bearing steel oxidizes on the surface to a dense, dark brown, adherent coating, and this

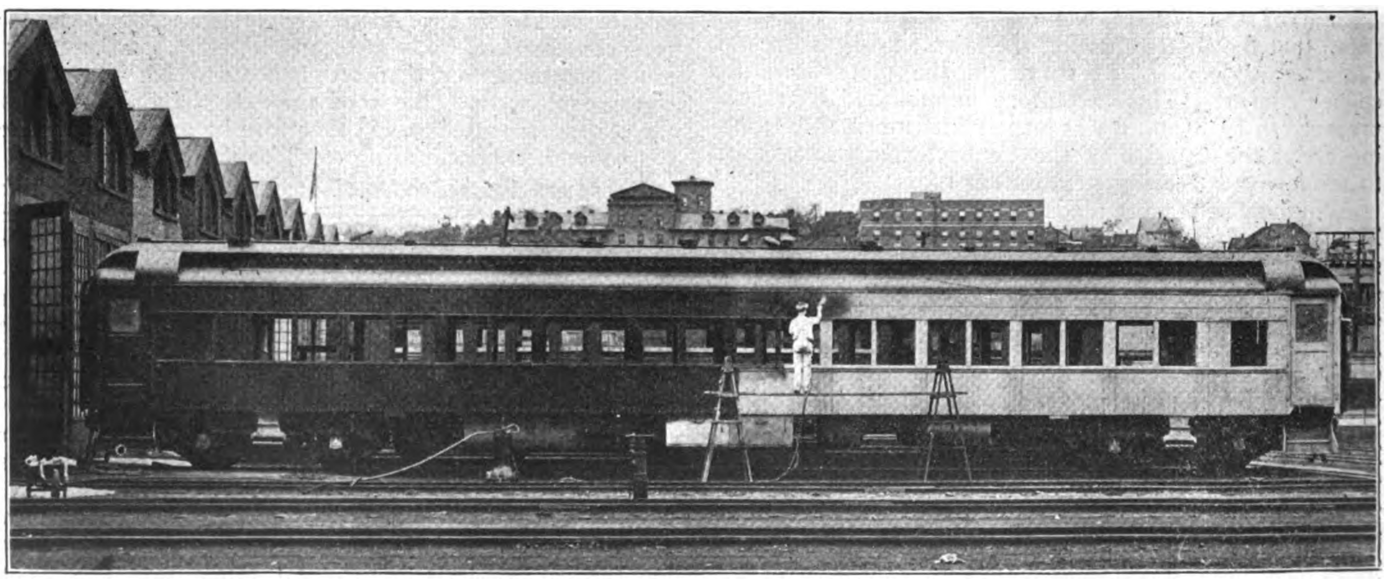


Variations in the rate of corrosion of steel

is believed to act as a protective measure against rapid destruction.

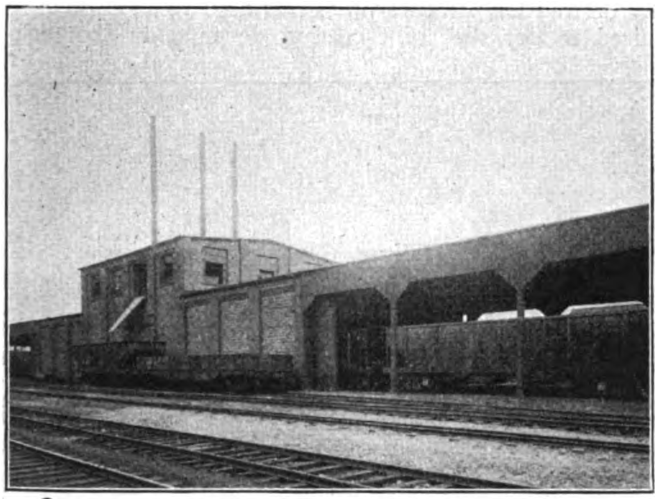
Method of protecting the surface of construction steel

The duties of the engineer do not end with the purchase of the best commercial structural metals now available. Steel for important structures, such as bridges, should



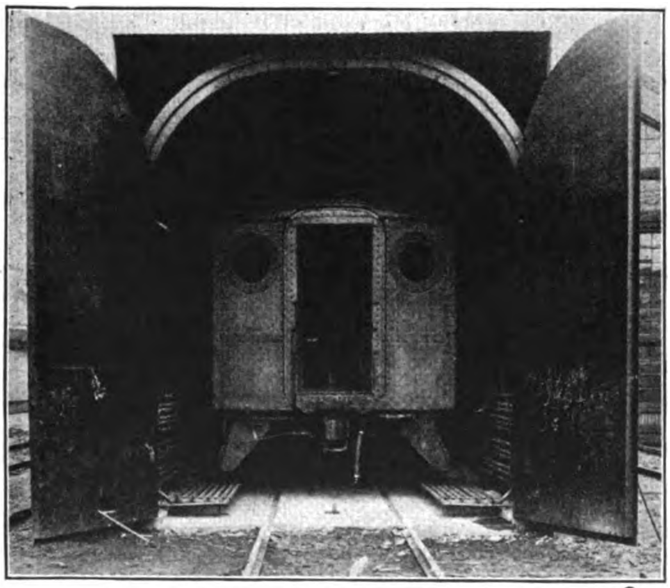
Applying Tuscan red lacquer finish to a car

receive a shop coat of good paint prior to its shipment from the factory and for this purpose red lead is still a favorite. Steel for rolling stock which is not painted should be stored in a dry place until it can be assembled and if this is not feasible a protective coat of some kind should be applied. The method employed by the Pennsylvania System, and we believe by numerous other concerns, is to apply a petroleum oil coating which contains resins and wax, these constituents being added to the oil for the



Baking ovens located at the Pitcairn car shops, which turn out 23 freight cars every 16 hours

purpose of imparting adhesive properties. On withdrawal of the steel from storage for use, the temporary protective coating is removed. After construction, exposed steel parts should be well painted. Many technical organizations, including our research staff, have devoted a large amount of work towards determining the most durable paints which can be applied. Experience teaches us that

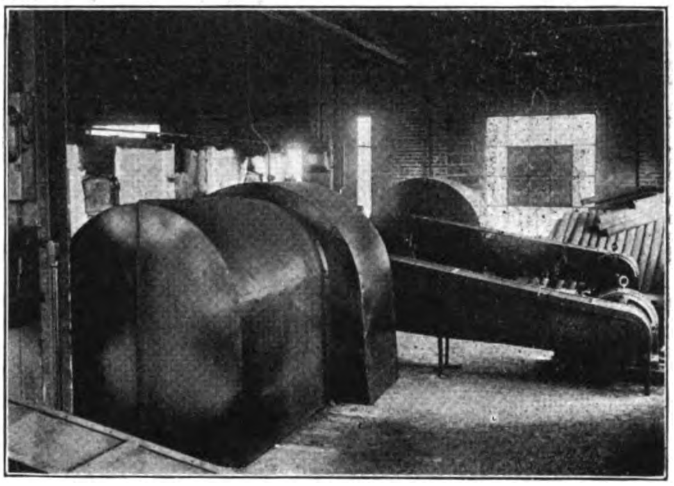


Baking ovens first designed and used at Altoona, Pa., 1913

the best air drying paints are those which contain suitable pigments, good oil and a minimum amount of drying constituents, such as Japan drier. Paints made in accordance with these precepts, dry slowly, and under conditions prevailing in industrial centers, the coating is likely to become contaminated with dirt before the paint film is set. Furthermore, the use of such paints on rolling stock keep it in the shops and out of service. Painters know that an excessive amount of driers shortens the life of paint. The action of the driers does not cease when the paint film has become dry, but continues after the purpose for which they were added has been accomplished. This leads to premature destruction of the paint film and while the fact is generally known, we have confirmed it by panel tests. Notwithstanding the known detrimental effect of these driers, painters sometimes use them in excess in order to get the equipment out of the shops in the shortest time possible.

Baking paint on passenger equipment

A laboratory baking oven was constructed and a large number of painted panels prepared, using different compositions. These panels were exposed on a test rack in comparison with panels painted with the usual air drying paints and varnishes in use. The panel tests showed that the baked coatings had greater durability than the air dried ones. The difference was so decided that a baking oven for passenger cars was constructed at the Altoona paint shops. The first car painted by the baking process was finished in January, 1913. One of the illustrations shows the exterior of this car after 40 months'



Fan and hot air furnace which supply the Pitcairn baking ovens

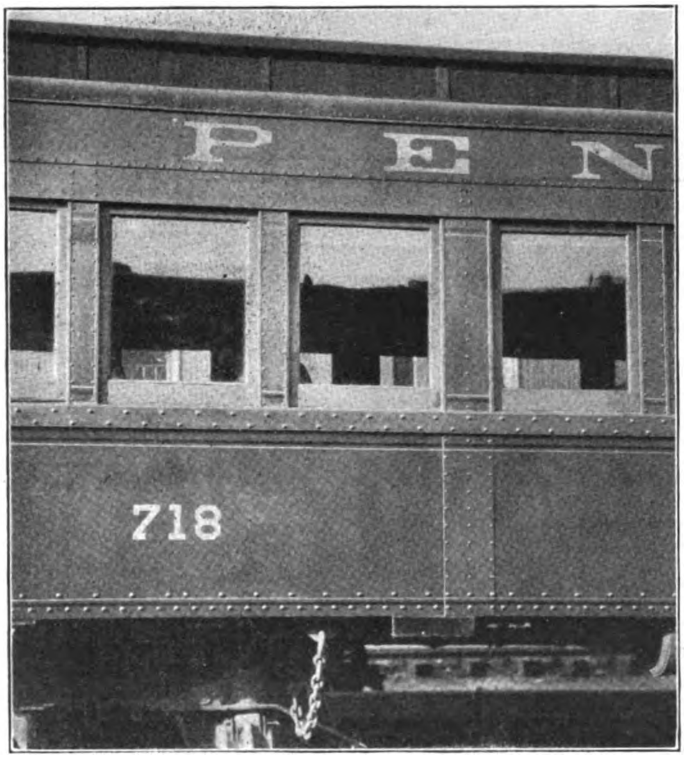
service. The paint was in good condition. Another illustration shows a car painted by the baking system in November, 1913, and photographed September 22, 1925. During this period, the car was in the shops for baking class repairs at three different periods. No color or varnish has been applied to it since June, 1923. These class painting repairs consisted of one coat of color and two coats of varnish to the exterior, and one coat of varnish to the interior. Cars painted by the baking process require class repainting every 36 months, while those painted by the air-dry process receive class repainting at intervals of 18 months. It requires 14 working days to paint a new passenger car by the air drying process, while by the baking process all of the painting operations can be applied in six working days. The baking process reduces the time which passenger cars must be retained in the shops on account of painting operations more than 60 per cent. There are now three baking ovens in service. One of them is illustrated which is 90 ft. 3 in. long, and will accommodate the largest cars in service. They are equipped with ventilators, and are heated by steam under a pressure of 125 to 150 lb. Each oven contains 2,000 sq. ft. of radiating surface. Temperatures of 250 to 260 deg. F. are obtainable. Baking paints, also the priming

and surfacing coats for passenger equipment cars, are dried in three hours at these temperatures. Varnish and light colored enamels used for the final coats on passenger cars darken at high temperatures. In practice they are dried in three hours at temperatures of 150 to 160 deg. F.

The coatings as applied to passenger cars by this method have been found to be very durable. All steel passenger cars from which it is necessary to remove the old paint are sent to Altoona, Pa., to be repainted by the baking process. All cars painted by the baking process are marked, and when they require class painting repairs, the additional colors and varnishes applied are dried in these ovens.

Baking paint on freight cars

In addition to the baking of paint coatings on passenger cars, the method was applied to some 1,100 freight cars in 1913. These were coal cars which were in need of paint. They were given one coat of baking paint in which different oils were used, including Menhaden fish, corn, cotton seed and soya bean oils, with linseed and China wood oils. None of the paints used contained artificial driers. The paint on these cars was dried in an oven at South Amboy which was used for thawing cars of frozen coal which were to be dumped into boats. The temperature obtainable was 185 to 195 deg. F. and it



Car finished by the baking process November, 1913—Photographed October 22, 1924

required six or seven hours to dry the paint. The cars were repeatedly inspected for about five years and the results obtained were so satisfactory that baking ovens were authorized and built at the Pitcairn car shops in 1923.

The Pitcairn installation is shown in one of the illustrations. It will be seen that they are different from the Altoona ovens previously described. There are three units over parallel tracks, each of which will accommodate three freight cars at one time. Each unit is provided with a coal-fired hot air furnace containing 40 tubes through which air is circulated by means of fans. The air to be heated is drawn from the top of the baking oven, passed through the tubes of the hot air furnace, and forced back to the bottom of the ovens through suitable ducts. The circulation of the air from the ovens through the furnace is continuous. However, provision is made for a little ventilation. A vent is provided for discharging some hot air from the top of the ovens to the atmosphere, and this loss is replenished with fresh air which is drawn through an intake into the plenum chamber of the fans. The furnace, the fans and the motors which operate them are illustrated herewith. These ovens permit the control of any desired temperature up to 360 deg. F. The time required to dry the paint coating depends on the temp-

Condition of the exterior panel of the first car finished by the baking process after 40 months' service

erature. If the ovens are operated at 225 to 250 deg. F., the painted cars are allowed to remain in them for three hours, and at 275 deg. F., the time is reduced to two and one-half hours. Thirty-two cars are now painted daily at Pitcairn. Each car receives two coats of paint, both of which are baked from two and one-half to three hours, after which they are stenciled. The paint is sprayed on, and two shifts of painters perform the work. It is possible by this method to apply two coats of paint and stencil the cars in one full working day after the cars are delivered to the paint shed, it being understood that due to two shifts of employees, a working day is 16 hours. No artificial driers are added to the paint used and a large percentage of Menhaden fish oil is used in thinning the paste paint, which is ground in linseed oil. A small percentage of China wood oil is used, as our tests and experience indicate that this addition increases the water resisting properties of the paint film. It is estimated that the time saved in painting cars by this operation is two days. In other words, the cars are available for two more days revenue service. By this method of painting cars, unexpected delays due to failure of the paint to dry on account of bad weather conditions is not experienced. The method will likely be extended to other shops.

Lacquer method of painting equipment

The extension of the baking system for passenger cars to other shops has been deferred pending the outcome of tests which are being conducted with the lacquer system which has recently revolutionized the method of painting automobiles. These lacquers contain a colloidal solution of nitrated cotton and varnish gum in a mixture of volatile solvents, which usually include ethyl acetate, anhydrous alcohol, benzene or toluene and other volatile constituents. Pigments are incorporated with this solution to give the

desired color, and to make the resulting film durable. Lacquers of this type dry so quickly that they cannot be satisfactorily applied by means of a brush. They are applied with spray equipment. The Pennsylvania System now has five passenger equipment cars and over 100 locomotives which were finished with lacquer. The operation of finishing the exterior of a passenger car with tuscan red lacquer is shown in one of the illustrations. The exterior of a car can be coated without difficulty. There is some trouble in finishing the interior of cars due to the fact that several colors are used. If the headlining is to be light green, the body of the car bronze, and the base dark green, any one of the colors can be applied, but in the application of the adjoining color by means of a spray gun, it is difficult not to spoil the first color applied. Another difficulty is encountered if it is desired to apply gold striping or lettering over a lacquered surface. The gold must be protected, and this is now done by pencil varnishing it. This is a time consuming operation. The lacquer coating can be quickly applied and successive coats can be sprayed at intervals of about 30 min. Means will probably be devised for overcoming the present difficulties. When properly made, applied and polished, these nitrocellulose base coatings present a pleasing effect suggestive of refinement. Lacquer finishes can be cleaned more easily than the more familiar varnish coatings.

The progress in the development of rust preventives has been rapid during the past decade. The successful engineer must ever be alert to the end that his client may receive the benefit of the best information obtainable.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Interchange Rule 32 again upheld

On January, 1923, St. Louis, Troy & Eastern empty coal car No. 1034 was being handled in switching service by the Chicago, Rock Island & Pacific, during which time it was broken in two while making a coupling. The car owner received a request from the handling line for a disposition of the damaged car to which was attached an inspection report which in substance showed that all of the eight sills were broken in 32 different locations and that the car body was practically demolished. It was estimated that it would cost approximately $1,000 to repair the car. The car owner sent several inspectors to examine the car and after receiving their report, advised the handling line that in its opinion the car had received unfair usage and agreed to settle according to A. R. A. Rule 112. On March 29, 1923, the Rock Island refused to handle the car according to Rule No. 112 and stated that the damage was due to decayed side sills. On April 12, 1923, representatives of both companies made a joint inspection of the car body after which both agreed that the eight side sills had been broken in 32 different places. The car owner based its contention of unfair usage on the fact that the body of the car had been turned over on to the opposite track although the trucks still remained on the track. This indicated that the car had been coupled on at a speed exceeding the limits of safety, which constitutes unfair usage according to A. R. A. Rule 32, Section D. The handling line stated that the car had not been subjected to unfair usage for according to testimony by the engine and yard crew, the coupling was made at a speed of from two to four miles per hour. There were no other cars damaged at the same time, neither was car No. 1034 or any other car derailed. The car failed owing to the fact that the sills were decayed on top in the center which was not fully disclosed until the decking had been removed. With these facts in mind the handling line took the position that the damage occurred in ordinary switching and inasmuch as the car was not derailed, cornered, sideswiped, or subjected to any other unfair usage as defined in Rule 32, the car owner should furnish disposition in accordance with Rule 120.

The Arbitration Committee rendered the following decision, "There is no evidence that the car was subjected to any of the unfair usage conditions of Rule 32. The car owner is responsible."—*Case No. 1338, St. Louis, Troy & Eastern vs. Chicago, Rock Island & Pacific.*

Labor charges for testing and adjusting steam coils on tank cars

The Pierce Oil Corporation, at its Sand Springs, Okla., plant, tested and adjusted the steam coils in A. T. & S. F. tank car, No. 96064 and in 17 other cars and submitted a bill for $30.45 to cover labor charges. The owner requested cancellation of these charges claiming that the work should have been considered inspection and under Rule 108 of the 1920 Code of Rules, no labor charge should have been made. The handling line stated that the tank cars were sent to its refinery for fuel oil loading and in accordance with I. C. C. regulations, Section 2, Article 1822E, the tanks and fittings of these cars were inspected and found to be in a defective condition due to leaks, making it necessary to tighten up loose and leaky connections. The handling line further contended that it was in no way responsible for the leaky condition of the cars and that Rule 108 applies only to ordinary train yard inspection and has no bearing on inspection or repairs to the parts in question.

The Arbitration Committee in rendering its decision stated that, "Rule 108 prohibits a labor charge for inspection of cars, tightening unions, etc. Therefore, the bill of the Pierce Oil Corporation should be withdrawn.—*Case No. 1339, Atchison, Topeka & Santa Fe vs. Pierce Oil Corporation.*

Labor charges for application of wood end posts with metal fillers

The Illinois Central rendered the following bill to the Southern Pacific for the application of wood end posts with metal fillers:

2 wood end posts at 5.5 hr. each, total	11 hrs.
2 metal end posts filler plates	
20 metal end posts filler plate bolts at 0.2 hr. each	4 hrs.
Total	15 hrs.

The Southern Pacific took exception to this bill on the grounds that the four-hour charge was excessive for applying the metal plates to these posts. It further contended that the labor charge for applying these posts is based on the material charge for lumber for the posts and wrought iron for the fillers which contemplate the framing of these posts and according to Rule 107 the labor allowance for the application of posts to cars includes all work necessary to complete each item of repair unless the rules provide that additional labor may be charged, and that as Rule 107 does not provide additional labor for the

application of fillers and as the item of repairs is not complete until these plates are applied, the arbitrary charge of 11 hrs. cannot be exceeded. The Illinois Central contended that the bill was correct in accordance with Item 249 of Rule 107, inasmuch as it does not list such bolts among the items intended to be included in the labor charge of 4.4 hrs. for a post. Furthermore, because few companies have their cars equipped with end post plates, the Illinois Central maintained that the committee omitted the charge of 4.4 hrs. for end posts renewed, and that therefore, the Southern Pacific's reference to the first paragraph of Rule 107 has no bearing whatever on the question.

The Arbitration Committee in rendering its decision stated that "The total labor charge should be reduced to 11 hours, which is the average allowance permitted in Item 249, Rule 107 of the 1921 Code.—*Case No.* 1341, *Southern Pacific vs. Illinois Central.*

Interchange inspectors' discussion of new rules

Report and discussion of C. S. Cheadle's paper on the prevention of transfers and claims arising from transfers also included

Aside from the presentation of papers, abstracts of some of which have been published in the two preceding issues of the *Railway Mechanical Engineer,* the second and the last day's sessions of the Chief Interchange Car Inspectors' and Car Foremen's Association convention held at Chicago, September 22, 23 and 24 were devoted principally to the discussion of new interchange rules. These rules are abstracted in this issue, together with a highly constructive paper on the subject of transfers and the claims arising from them, by C. S. Cheadle (R. F. & P.).

Prevention of transfers and claims arising from transfers

By T. S. Cheadle

Chief car inspector, Richmond, Fredericksburg & Potomac.

The transferring of carload freight affects the service expected of railroads and causes losses of revenue to shipper or consignee as well as the railroads. It affects all departments of a railroad to such an extent as to demand the careful attention and co-operation of every one having to do with shipments in an effort to reduce the enormous loss suffered as a result of transferring the load enroute.

The transfer problem on the railroads is as old as their institution and was the main factor in bringing about standardization of track gage and car parts. There are a number of men in railroad service today who remember changing car trucks at interchange points to prevent transfer of passengers and freight and expedite movement of cars.

In the table is shown the result of a check of cars transferred from January 1, 1925, to June 30, 1925, inclusive, by the railroad with which I am connected. The transferring was done in connection with interchange of cars by seven Class I truck line roads under point arrangements and no doubt represents the average condition under A. R. A. Rules of Interchange.

It will be noted that more cars were transferred on account of conditions over which the mechanical department had no control than for ordinary wear and tear mechanical defects.

No way has been found to overcome the loading of house cars which are too high and wide. A card has been printed, worded as shown in Figs. 1 and 2, with the dimensions shown on the opposite side for routing through the Potomac yard gateway. For some time these cards have been attached to all cars when empty on our road. This was done with the view of informing agents, inspetcors and shippers of the unsuitability of cars for shipments routed through the Potomac yard gateway. If

RICHMOND, FREDERICKSBURG & POTOMAC R. R. Form M. P. 103

THIS CAR TOO HIGH AND WIDE FOR NORTHBOUND MOVEMENT THROUGH POTOMAC YARD

DO NOT LOAD VIA THIS ROUTE AS IT WILL NECESSITATE THE TRANSFEER OF LADING

Fasten on Car With Six Tacks, Three on Top and Bottom Edge.

Fig. 1—Front of card applied to cars too large to pass through the Potomac yard, R. F. & P.

it could be arranged to stencil all cars which exceed the standard dimensions, it would be a great benefit. However, under Car Service Rule 14, the receiving line is chargeable with the cost of transfer and unless this is made a loading line responsibility some will continue to load such cars.

The matter of cars being transferred on account of being unsuitable for perishable commodities which do not require icing; that is, ventilated cars loaded instead of refrigerators, is being handled by a special committee and test is being arranged to determine the suitability of the ventilator car as compared with a refrigerator car, where icing is not required.

The cost of transferring overloaded cars is chargeable to the delivering line; however, cars often pass several interchange points before being stopped. It should be made a loading line responsibility. This would often result in cars being delivered without being transferred.

No rule can be devised that will overcome the necessity of the mechanical department closely supervising or having charge of the transferring of cars. In every case, a

thorough inspection should be made by a competent inspector, one who is thoroughly familiar with shop track work and who is capable of using sound judgment in deciding whether a car should be repaired or transferred. Where this is not being done, if adopted, it will overcome a large number of transfers now being made.

Mechanical defects causing transfer are the result of poor design, improper construction, rough or improper handling (largely from use of the independent air brake), failure as the result of age, due to decaying, corroding, or wearing out and breaking as the result of fatigue, the misuse of the car in loading a commodity for which it is not suitable, improper loading and leaking tank cars.

WIDTH LIMITS FOR CARS AND LOADS
NORTHBOUND VIA POTOMAC YARD
Centre to Centre of Trucks

Height Above Top of Rail		30 Feet				40 Feet				57 Feet			
		Cars		Loads		Cars		Loads		Cars		Loads	
Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
15	6	1	11	..	..	1	10	..	..	1	9	..	..
15	3	3	0	1	11	2	11	1	10	2	10	1	9
15	0	4	6	3	0	4	5	2	11	4	4	2	10
14	10	5	0	3	10	4	11	3	9	4	10	3	8
14	8	5	10	4	9	5	9	4	8	5	8	4	7
14	6	6	6	5	7	6	5	5	6	6	4	5	5
14	4	7	1	6	3	7	0	6	2	6	11	6	1
14	2	7	9	6	10	7	8	6	9	7	7	6	8
14	0	8	4	7	4	8	3	7	3	8	2	7	2
13	10	8	9	8	1	8	8	8	0	8	7	7	11
13	8	9	1	8	6	9	0	8	5	8	11	8	4
13	6	9	3	8	9	9	2	8	8	9	1	8	7
13	4	9	6	9	0	9	5	8	11	9	4	8	10
13	2	9	8	9	2	9	7	9	1	9	6	9	0
13	0	9	11	9	5	9	10	9	4	9	9	9	3
12	10	10	0	9	6	9	11	9	5	9	10	9	4
12	8	10	3	9	9	10	2	9	8	10	1	9	7
12	6	10	5	9	11	10	4	9	10	10	3	9	9
12	4	10	8	10	2	10	7	10	1	10	6	10	0
12	2	10	10	10	4	10	9	10	3	10	8	10	2
12	0	10	11	10	5	10	10	10	4	10	9	10	3
11	9	11	0	10	6	10	11	10	5	10	10	10	4
11	6	11	0	10	6	11	0	10	6	10	11	10	5
11	3	11	0	10	6	11	0	10	6	11	0	10	6

The equivalent width is the doubled distance from the center line of track to an outside point in line with widest part of car. Height, is from top of rail to highest point of measurement.

Fig. 2—Reverse side of the card shown in Fig. 1

Tank cars should be tested under oath to prevent a car being stencilled and put in service without proper test having been made.

The present standard and recommended designs, deserve the praise of all car men. Nevertheless, there is considerable shop track practice in rebuilding and repairing that should be avoided or condemned. Poor repairs are nothing but an expensive bad habit and often good permanent repairs can be made for less than a patched up botch job.

With the varied standard of inspection, the present rules are ideal for creating transfers. Any change in rules would help to prevent them. However, it is logical to suppose that a rule which should make the car owner or loading line responsible for transfer costs on account of ordinary wear and tear, would be progressive and equitable; it would leave it to the judgment of the car inspector as to whether a car was safe to reach the next point of inspection. If the owner was responsible, it would make it profitable that the car be kept in repair.

TRANSFER

INITIAL ______ NUMBER ______ DATE RECEIVED ______ 19__ FROM ______ KIND ______ DEFECT O or N

CAUSE FOR TRANSFER ______

IF OVERLOADED SHOW CAP. ______ TARE WT. ______ NET WT. ______ GROSS WT. ______

POINT OF ORIGIN ______ DESTINATION ______

SIGNATURE OF PARTY AUTHORIZING TRANSFER ______

TIME RECEIVED ______ INSPECTOR OR YARDMASTER. 7-10-22 5M

Richmond, Fredericksburg & Potomac Railroad Co.

ADJUST

Initial ______ Number ______ Date Received ______ 19__ From ______ Kind ______

Load Defects ______

Car Defects ______

Time Received ______ M ____ Inspector ______

Fig. 3—(Above) Front side of card to be attached to cars shopped for transfer of lading—(Below) Reverse side of the same card—Both sides are red, printed in black

At the same time the cost of switching and per diem would penalize the carrying line sufficiently to cause the movement of the car without delay and would result in the owner being willing to permit and accept charges for temporary repairs rather than to pay the cost of transfer.

The majority of car men will agree that an inspector has exercised good judgment and performed his duty properly when he passes a car safely to the next point of inspection. This, however, cannot be done under the present rules without penalizing his line, and the inspector has to anticipate what will be the judgment of inspectors at every interchange point which the car will pass en route to destination, and in doing this cars are shopped and transferred which should run. This brings about a point of view that "if you will not, I will not." This also applies to improper loading, use of small stakes and tie boards, and improper bracing.

A rule that would give chief joint car inspectors, or some competent car man where there is no joint inspection, at principal gateways, the authority to route a car home to the owner when in need of rebuilding (Car Service Commission to enforce repairing of car) would prevent

the loading of worn out cars more than any one thing and would increase greatly the average miles per day of loaded cars. In addition, the definition of a serviceable empty car should be changed to read, "A car suitable for any commodity for which it is intended to be used." And for a loaded car, "One which will carry its load safely to destination." This is necessary for the reason that it is rare in interchange that an inspector knows what the car will be used for when it is loaded. He, therefore, has no opportunity to exercise his judgment.

A summary of things that would prevent transfer includes equipment of good design and construction; substantial repairs to old equipment; a change in rules which will enable inspectors to use their judgment as to the safe movement of the car; a rule which will make it profitable for the handling line to run the car and also make it

Form P. Y. 1098 10-24-23 5M

Richmond, Fredericksburg and Potomac R. R. Co.

Potomac Yard—Bulk Transfer

____ Car No. ____

Lading ____

From ____

To ____

Final Destination ____

Routing ____

Shipper ____

Consignee ____

Gross ____ Tare ____ Net ____

Capacity of Car ____

Seals arriving West ____

" " East ____

Road off ____ Date ____ Time ____ M.

LADING TRANSFERRED TO

____ Car No. ____

____ Car No. ____

____ Car No. ____

Cause of Transfer ____

Date of Transfer ____ 192__

If for exceeding dimensions—show same.

Height ____ Width ____

C to C ____ Overall ____

Responsibility for Transfer ____

Lading Consists of ____

Fig. 4—Record card on which the essential facts pertaining to a transfer of lading are recorded for the use of the claim department

Condition of lading upon receipt ____

____ Exceptions by ____

Shipment checked ____

Time original car was placed ____

Amt. ice ____ Vents ____ M.

" " in receiving car when placed ____

" " transferred with lading ____

Time completed ____ M. Reported ____ M.

Condition of vents and bunkers—receiving car.

Amt. ice ____ Vents ____ Temp. ____

Seals applied to receiving cars ____

NAMES OF WORKMEN

Price allowed laborers ____

Inspector of lading charge ____ Total ____

Remarks: ____

Fig. 5—The reverse side of the record card is a continuation of the information for the claim department

profitable for the owner to repair, adding a rule by which worn out cars can be sent home for repairs, and giving a definition of an empty car which will work in interchange.

The prevention of claims as the result of transfer is a very hard matter to overcome, as it appears that the consignee almost invariably accepts the knowledge that transfer was made as an invitation to make a claim.

It is thought by a good many mechanical men that claim departments deal too largely in a stereotyped manner, in securing information by the use of forms, widely distributed, among men who often carelessly furnish information which is not based on a knowledge of the facts and the consignee is sometimes furnished with information which encourages claims.

The prompt handling of a car shopped for transfer is one of the most important points in connection with this subject, as delay increases the possibility of a claim. When a car is shopped for transfer, a stiff conspicuous tag, as shown in Fig. 3, should be attached to the car. The car should be placed promptly, together with a car in good order. The latter should be a good looking car as it is human nature for the consignee to be affected by the looks of the car in which the load is received; transfer tracks located conveniently to the switching territory, properly spaced, will add materially to the quick transferring of the car. Proper supervision of the transfer forces is another of the most essential things in connection with proper handling of the commodity and a record should be made correct in every detail for use of the claim department, such as is shown in Figs. 4 and 5. Extreme care should be exercised on practically all commodities to see that they are placed in the receiving car in a manner as near as possible like they were when originally loaded, if this loading was properly done, and that proper bracing and door protection is afforded, if necessary. Gum shoes, clean gloves and hands should be used in connection with careful handling of dressed or fine lumber to prevent marking, defacing or injuring tongues or grooves; hooks and canthooks should not be used where it will injure lading. Watermelons, canteloupes or such commodities should be topped as near like the original load as possible. Baskets should be provided for handling bulk apples, oranges or such fruits, that are liable to bruising in handling. A record should be required of yard and mechanical forces showing the delay and its cause in handling cars for transfer.

Statement of cars transferred, showing the defects making such transfer necessary and the total cars handled in interchange by the R. F. & P. with the A. C. L., B. & O., C. & O., Penna., S. A. L. and Southern from January 1 to June 30, inclusive, 1925.

Loaded cars interchanged		513,594	
Empty cars interchanged		100,682	
Total		614,276	
Cost	$12,735.36		
High and wide house cars		897	
Not suitable for perishable lading		295	
Ends knocked out		177	
Overloaded		79	
Fire damaged		1	
Wrecked		24	
Shipper's request		18	
Damaged lading		1	
Total			1,492
Center sills		172	
Truck bolsters and transoms		127	
Bulged		92	
Truck sides		85	
Body bolsters		71	
Leaning in center		60	
Draft gear		46	
Center casting		26	
Safety appliance		22	
Side sills		13	
Improperly loaded		3	
Bad rigging		3	
Leaking tank		3	
Car floor		1	
Total			734
Grand Total			2,226

It appears that no accurate data have been compiled to show loss as the result of transferring cars. It is estimated by various sources that all cost considered, losses will average $60 per car. Under any condition the cost is high, and the management of railroads, when they fully realize the effect, will apply a remedy.

Discussion

Mr. Campbell: I heartily agree with Mr. Cheadle's paper. I think it would be beneficial to the railroads to spend more money to repair cars rather than to transfer and especially with many commodities that are liable to damage claims, like automobiles. At Minneapolis, we make it a point not to transfer automobiles. We are spending $50 to $60 a car to avoid it. If the railroads will do more of this thing, they would get away from a lot of claims.

Mr. Hanson: I would like to ask Mr. Cheadle who handles the cards which he showed here, the joint inspector or the transportation department?

Mr. Cheadle: All the cards are handled by the inspector with the exception of the cards issued for overloading, which are filled out by the transportation department man and forwarded to the man who loaded the car. The mechanical department has supervision over the transportation department on the transfer tracks.

Mr. Trapnell: I would like to ask Mr. Cheadle when he transfers a car for transferable defect what disposition he makes of the empty?

Mr. Cheadle: About 50 per cent of the cars we repair ourselves and about 50 per cent are returned to the delivering line.

Mr. Trapnell: In the month of March, 1925, we transferred 462 cars out of 125,425 interchanged. I find that out of the 572 transfers asked for we refused 110. The number of cars repaired out of 462 was 81; number of cars not repaired, 381; number of cars not repaired and loaded out from point where they were transferred, 96; number run out empty to go out and get other loads, 114; number stored for repairs, 73, and number moved home empty, 76. Cars that should have been repaired by the receiving line in 20 or more hours were 258. We are throwing away the money of the railroad companies which we represent by the wholesale when it costs us 25 cents a minute to switch the car; in addition we frequently have to pay per diem for the car while it is held, to say nothing about loss and damage freight claims.

Discussion of freight car rules

Rule 2

The committee recommends that Bureau of Explosives' Pamphlet No. 20-J be incorporated in the next issue of the rules as an addendum for the information of car inspectors, with a designating mark opposite Section (b) of Rule 2 calling attention to same.

The committee recommends that second paragraph of Section (h) be modified as follows:

Proposed Form—For inside door protection, *side or end*, the car transfer check, issued by the road having car in its possession, shall be authority for bill against road on which load originated, for cost of adjusting load due to absence of, or improper inside door protection, as well as cost of applying or correcting such protection. (See Section (e) A.R.A., Car Service Rule 14.)

Reason—To harmonize rule with action of joint conference between Mechanical and Transportation Divisions.

T. J. O'Donnell (Buffalo, N. Y.): Is it understood by all that the rule would apply to a small end door window or would it apply only to an end door?

T. S. Cheadle (R. F. & P.): It has been my impression that it would apply to any end door.

Mr. O'Donnell: How are you going to hold the loading road responsible and how are you going to charge for

the cost of adjusting the load, due to the absence of proper inside door protection?

Mr. Cheadle: By what our committee rules, I think the delivering line really stands for any small end door protection that we have to apply.

Mr. O'Donnell: Will the delivering line understand that the charge is for any end door?

Secretary Sternberg: In my opinion Mr. O'Donnell is correct. I do not think the intention is to go so far as the small end door.

Mr. Cheadle: It is my position that it would apply only to vehicle door but as the rule reads it would apply to any end door; I do not think in the case of some kinds of lading they would insist upon protection against the end door.

C. J. Nelson (C. I. E., Chicago): It is my opinion that the rule as it is now written will probably only be applied to the vehicle cars, in the majority of cases. I think that Mr. O'Donnell probably has in mind the small end door which is being used on cars today but there is a possibility of end doors of different design being applied to cars in the future and it seems to me it does no harm to include small end doors. There are times when the shipper really should cover the end door when he puts certain kinds of loading regardless of how small it may be and as I understand it the labor charge is actual and cannot be a great burden to anybody, to render a bill against the originating line for necessary protection on the small door. I quite agree as to the necessity of having to remove the load on many occasions to apply this end door protection which may not amount to a great deal, but I see no reason why the receiving line should assume that expense and it seems it would be very well to take the rule literally.

G. Lynch (Cleveland, O.): I think the proper method of procedure would be to make a motion to refer this matter to the Arbitration Committee for decision.

F. W. Trapnell (Kansas City, Mo.): I move that it is the understanding of this body that the rule includes any end door. The motion was carried.

Rule 4

The committee recommends that the second paragraph of this rule be changed as follows:

Proposed Form—Defect cards shall not be required for any slight damage (new or old) that of itself does not require repairs before reloading of car, *except that the car may be used, under load, in movement to shop for the required repairs.*

Reason—The recommended modification is a reasonable exception to the general rule, which contemplates that cars with defects requiring repairs shall not be continued in service indefinitely. The general restriction against reloading defective cars is advisable as a measure against the improper issuance of defect cards for unnecessary repairs.

With reference to second sentence of present rule, the experience has been that in many cases it is practically impossible to determine whether the defects were new or old.

Mr. Bell: It occurs to me in connection with this, that a car might be unloaded and reloaded before it returns to the owner, so that the wording of the rule gives the owner no protection in that case.

Rule 8

G. P. Zachritz (M. St. P. & S. S. M.): The note after Rule 8 which refers to the changes in the billing and wheel repair cards and provides that the present repair card (used at that time) may be used until the supply is exhausted. The note contemplated that when that supply was exhausted the roads would supply billing repair and wheel repair cards as shown on Pages 199 and 201 of A.R.A. Rules effective January 1, 1925.

Some of the roads are still buying repair cards and wheel repair cards which are not standard. Some of them have an additional column headed "money," and instead of using the "net price" column for all items expressed in money they divide the items between the "net price" and money columns.

Some of the roads do not put the prices on the wheel repair card and some of them bunch the price of the wheels, the axle and the labor of applying wheels and carry it to the money column on the repair card which necessitates the car owners repricing the entire repair in some instances.

I suggest that the Arbitration Committee ban the use of non-A.R.A. repair and wheel repair cards and where cards are not priced in accordance with the instruction as per the different headings on the billing repair card and wheel billing repair card, it be left to the option of car owner or company billed whether to reprice and check the bill and voucher same or return it to billing line to be properly priced.

Rule 9

The committee recommends that the information to be specified on billing repair cards after item of Brake Beams, R. & R., be modified as follows:

Proposed Form—New or second-hand, applied. If A.R.A. and number of same, or non-A.R.A. Cause of removal. Location number (see Rule 14).

Reason—This information unnecessary in the proper preparation of repair records.

Mr. Herbster: At this time I wish to call the attention of the members to brake beams applied generally by a good many railroads that would not pass A.R.A. test. The road I am connected with is removing a number of beams every day with small truss rods, undersized fulcrum; in fact, any and all kinds of material applied by other railroads, or by industries, and I believe we should impress upon the members of this association that they centralize their brake beam repairs so that the work can be properly done and meet with A.R.A. regulations.

The Chair: I concur with what Mr. Herbster has said, and if all present handle accordingly it would be very beneficial.

Rule 30

The committee recommends that Section (g) of this rule be modified as follows:

Proposed Form—When a car is *reweighed and* remarked the car owner must be *promptly* notified of the old and the new weights, with place and date. The proper officer to whom these reports should be made will be designated in "The Official Railway Equipment Register."

Reason—These reports should be furnished promptly.

Mr. O'Donnell: I wish to bring out the fact that a number of roads are simply re-weighing and re-stenciling cars in large numbers and they do not put on the A.R.A. standard size stencil. The idea is that we are obliged to give joint evidence and your loss is $3, or whatever you are getting for it.

B. F. Jamison (Southern): I might add that not only many railroads are re-stenciling cars in that manner, but many car owners are not using proper stencils. Some use one size figures and some another. I was in a shop lately where they were re-weighing cars and putting the lightweight on in 12-in. letters, that was the owner's standard and they had to go cut a stencil to meet the owner's standard. That, to me, is where standard marks would benefit, and I think some of us owners better take notice of this.

J. N. Brandon (M. St. P. & S. S. M.): A great many railroads have small capacity cars that have non-standard axles. I would like to ask what practice is used on other roads in re-stenciling these cars when they are re-weighed. Under new ruling, Rule 30, we have to re-stencil all cars with suitable capacity, etc. With a car 60,000-lb. capacity with non-standard axle we have nothing in the rule to cover it, and I would like to know what method is used on the different railroads for stenciling these cars.

Mr. Herbster: Isn't it given on Page 101 on 40,000 capacity cars?

Mr. Cheadle: I think that is the answer.

Rule 32

The committee recommends the addition of a new second paragraph to this rule, to read as follows:

"Steel tank heads (on tank cars) burst, except when due to inferior material, material less than required thickness, omission of reinforcing shoes where required, burned in flanging, welds or other improper workmanship; in any of such cases handling line must furnish car owner with statement showing actual condition of tank head which caused the failure."

Reason—To protect car owner against such damage unless failure occurs under any of above described conditions.

The committee recommends that Item 4 of Section (d) of this rule be changed as follows:

Proposed Form—No rider protection when necessary, if car is damaged to the extent shown in *Rule 44. The same responsibility applies also, if car is damaged to the same extent (per Rule 44), due to defective or inoperative hand brake rigging while handling car with rider protection, even though such faulty conditions may have developed during the switching operation.*

Reason—The elimination of Item 4 from Section (d), and the substitution of combination factors on certain classes of tank cars to constitute handling line responsibility, as proposed by the American Petroleum Institute, is not concurred in.

The committee recommends that Item 5 of Section (d) of this rule be modified as follows:

Proposed Form Coupling on with locomotive *when first car is damaged, including damage to adjoining cars (in consecutive order) in same draft.*

Reason—Reference to speed limit has been eliminated. The revision conforms to Interpretation No. 11.

The committee recommends the elimination of the last paragraph of this modified as follows:

Present Form—Defect cards shall not be required for any slight damage (new or old) that of itself does not require repairs before reloading of car. In no case shall defect card be required for raked or cornered sheathing, roof boards, fascia, bent or cornered end sills, if defects are old.

Reason—Covered by second paragraph of Rule 4.

Mr. Cheadle: It looks to me as though it is a big change in the rule. It used to be that if a car came over the hump with "rider protection" and damage occured it would be up to the car owner, but this new rule eliminates that. If you handle a car now with brake inoperative or defective the handling line is responsible.

Mr. O'Donnell: Why should not the man in charge of the car going over the hump be supposed to look over the car before it goes over the hump and see that nothing is wrong?

M. E. Fitzgerald (C. & E. I.): We have an arbitration decision between two Chicago lines, where the association has already recognized the fact that we must have effective hand brakes in going over he hump; we had the same protection all last year.

Mr. O'Donnell: May I put a question before you before we leave Rule 32: the change made by the Arbitration Committee "coupling on with locomotive when first car is damaged, including damage to adjoining cars (in consecutive order) in same draft." If the first car is damaged which is being coupled onto the locomotive and the second and third cars are all right and we have some damage after this, who is responsible?

Mr. Trapnell: My understanding is that if in coupling on with an engine you damage the first and second cars and the third car is O.K., but the fifth car is damaged, that the handling line would assume the damage on the first and second car, but on the fifth car the damage would be owner's responsibility, because it is not in consecutive order, providing there is no derailment.

W. P. Elliott (T. R. R. of St. L.): I would like to ask a question under Rule 32: that part relative to bursting out of tank heads. There is an exception there that when a head bursts, due to inferior material, material less than required thickness, omission of re-enforcing shoes, etc., the owners would be responsible, but the owners must be given a statement. Does the fact that you give the owners a statement change the responsibility, say, for a case of an end breaking out on a tank car due to not being properly reinforced? Why make the owners a statement if it is the owners' defect?

Mr. O'Donnell: I think the Arbitration Committee has done absolutely right in placing the responsibility in the hands of the owner. You cannot arbitrarily charge tank owners for $80 or $90 simply due to unfair usage. Give him the facts as required by the Arbitration Committee as stated "in consideration of the foregoing it would be unreasonable arbitrarily to hold the handling line responsible for defects of this character."

C. F. Straub (Reading): Before we get away from Rule 32, I would like to call attention to interpretation No. 2, which reads:

Q.—When flooring planks are cut out and can be seen from the outside of car, who is responsible?

A.—They are cardable defects where they can be seen in interchange from underneath the car.

A good many open top cars have patch boards put on them and owners do not repair them. Are they still cardable? Should not this association go on record as getting this interpretation re-written or eliminated entirely so that there will be an understanding that floor planks are only cardable when they are cut out new?

E. R. Campbell (Miss. Transfer): This is a case of defect card demanded by the owner and in checking them we find that cars are not repaired when they go home and come back again.

Mr. O'Donnell: The rule does not say that cars must be repaired when under load. If the card is taken off before the car is loaded, then they have to inspect the car.

Mr. Campbell: Nevertheless floor plank cut out is expressly mentioned as a defect and should be given necessary specific mention.

Mr. O'Donnell: Do not card unless repaired.

Mr. Fitzgerald: There is nothing in Rules 4 or 32 that provides he has to card the car owner for old floor planks cut out. Mr. O'Donnell says if he does make repairs he takes the card off and card issued is authority to bill car owners by the line that issued it. We get the car moving over our railroad and issue defect card for small defects as mentioned by this gentleman who just spoke. We card cars home to owners for repairs. We have no way of following that car up and making the owner comply with the provisions of the card, and I take it that if a card is issued for that floor plank the owner can bill as if he makes the repairs.

Mr. Straub: This is a case of car owners delivering their own cars with floor planks cut out, but patched over. We cannot always patch these when they are delivered to us, but when they go back empty it can be plainly seen, and also it can be seen that they are old defects, but a defect card can be demanded because the interpretation of Rule 32 says so. All that is necessary to clear this up is to try to get a new interpretation at this time.

F. H. Hanson (N. Y. C.): In regard to damaged tank heads, I would like to get the opinion of this association as to who is responsible. If the tank car owners must all comply with tank car specifications and put push pole pockets on the body of the tank or truck bolster, and if they place these push pole pockets on the tank head, naturally the yard or train crew who are doing the work will use the push pole pocket wherever it is located, and I think you will all agree that it will weaken the head. If we found a tank of that kind would we have the right to refuse it in interchange?

Mr. Fitzgerald: I do not know of any rule that will prohibit the interchange of that car if car is in continuous service. Rule 3 does designate certain such conditions and certain exceptions covering the interchange of tank cars, but it does not cover the general specifications and details of the car. From what I can see I do not feel that you could refuse the car, but I do feel that in the event of any distortion of head due to that push pole pocket being located on the sill of the tank it is an owners' responsibility, providing this damage is brought about by the proper use of this push pole pocket, but if the mark indicates that the switchman has applied the pole outside the push pole pocket, then it is unfair usage.

Mr. Hanson: That is the point I wanted brought out, to make it more clear to the rest of us. We recently had a tank equipped in that manner and the car was switched and struck twelve other cars standing on the track, no damage being done. Half an hour afterwards the car was found wrecked and in correspondence with the owner we called attention to the fact that the push pole pockets were riveted to the sills, and they came back and said that although they agreed that the push pole pockets were riveted to the sill of the tank they would not accept

a bill for the damage. The rule is so written that all you have to do is to make a statement of the conditions you just referred to, attach it to the billing repair card and bill the owners. Make another statement forwarding to the freight claim department and that will clear you of the responsibility.

Mr. Campbell: I would like to ask a question under Rule 32 that is not covered by the rule. That is the responsibility for damage in unloading gondola cars with the clam shell. All there is in the rule is in reference to unloading machines. This reads "material missing from cars due to handling by unloading machines." We have a great many cars in our country that are unloaded with a clam shell; they drop the clam shell in and raise the bucket from the floor, at such an angle that it breaks the side boards. Is this owners' defect or is it the handling line's responsibility?

Mr. Fitzgerald: As I interpret the rule we are supposed to go a little farther, in other words, I do not think the A.R.A. would embody in this little book of rules all the general detail of conditions under which you are supposed to use Rules 4 and 32 with reference to carding defects. They say that any damage to equipment brought about by unfair usage except under certain conditions is handling line responsibility. If you have a foreign car on your railroad and in unloading the car with a clam shell you break the car as the bucket raises or in any other manner, such as broken side stake, etc., it is a cardable defect and a handling line responsibility, the only protection you have is to repair the car at your expense and handle with the shipper through the transportation department to bring about better conditions at that plant. In a majority of cases if you talk with the shippers you can reduce the damage considerably, but it is a cardable defect.

Mr. Elliott: I consider that unloading a car with a clam shell in fair and ordinary handling will continue, and everybody is doing it. It is not cardable.

Mr. Cheadle: We do not consider a clam shell an unloading machine.

Mr. Herbster: In recent years we have contended that car construction must meet with the conditions under which it will be moved, and it is a fact that old equipment has been destroyed and owners are replacing the old equipment. I do not see why equipment cannot be put in condition to withstand ordinary handling. If the equipment does break up by reason of loading with a clam shell, I believe the owners ought to be responsible.

Mr. Cheadle: The rule says, "Material lost from cars due to handling on unloading machines." If you can get a claim charge on that I do not know how you do it. Rule 32 does not deal with the question of unloading, except in that paragraph.

Mr. Nelson: It seems to me that it would be very unfair to consider clam shell damage owners' responsibility. Some very expensive damage is done by clam shells on many of the modern cars. We have seen these hopper cars practically wrecked on the inside. I realize, however, that it is a very difficult matter to tell clam shell defect from other defects. There is no question but that many defects cards are issued today on assumed clam shell damage that should not be issued. But I agree that it is delivering line's responsibility and that it would be no more than fair to charge for all clam shell damage.

W. M. Allison (D. T. & I.): Recently we had this question up with one of our connections. We thought it a cardable defect in interchange. Meantime we wrote to Mr. Hawthorne of the Arbitration Committee and he advised that while it was not a cardable defect in interchange, it is up to the handling line where damage is done to protect car owner for such damage. Knowing we were more or less responsible for this damage, we gave card, and I believe this is in line with the Arbitration Committee's decision.

Secretary Sternberg: We in Chicago always feel that in cases of this kind we are fully taken care of by our Joint Inspection and we are satisfied.

Rule 91

The committee recommends that Section (c) of this rule be modified, a new paragraph be added as Section (d), and that present Sections (d) and (e) become new Sections (e) and (f) respectively, as follows:

Proposed Form—(c) No bills shall be returned for correction on account of other error or questionable charges unless the net amount involved is at least $1 and exceeds 10 per cent of the total amount of bill, but shall be passed for payment at once and the alleged error brought to the attention of the billing company within 60 days from date bill is passed for payment, but in no case exceeding six months after first receipt of bill. The billing road must furnish proper explanation or shall issue within 30 days countercharge authority on form shown on page 197.

(d) If objections to bill, as per Sections (b) and (c), do not amount to $1 in aggregate, no exception shall be taken, but bill shall be passed for payment as rendered. In any case, however, if entire bill is improperly rendered, it may be returned regardless of its amount.

Reason—To clarify the rule.

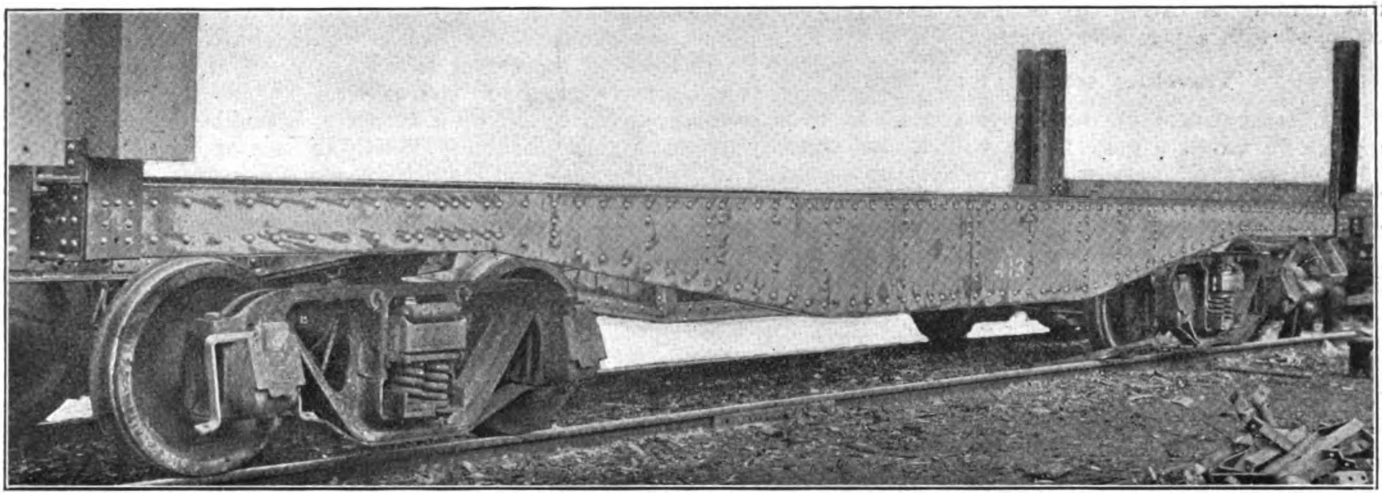
D. E. Bell (C. N.): There is a question I would like to have answered in connection with rendering bills. We have had at times some controversies on account of the similarity in car markings on several roads. It was our practice where the entire references were incorrect to render a bill, and I remember on some occasions that the other railroad companies objected to bills being rendered.

Mr. Jamison: I believe anyone from a billing office will bear me out in the statement that this particular rule is hard to live up to and by mutual consent the various railroads give and take on the proposition because 30 days is a short time in which to handle objections. That time goes by rapidly, particularly on railroads which have not adopted any progressive movement in their billing departments, such as centralization of billing. On the line with which I am connected, we have our own methods of centralization and all repair cards are prepared in the main office of the various divisions and we have been able to expedite greatly the handling by that method, and are trying as nearly as possible to live up to the letter of this rule. We have had very little trouble in handling that matter though, because the majority of the other railroads have to be lenient to others because they have to ask the same leniency for themselves.

Mr. Bell: Then no bill should be returned for correction, but should be passed for payment at once. We can correct car number or initials, but if entire bill is out of order, that is, if all the references are wrong, there is a question whether it would be handled under Section B or under Section D. In many cases the entire bill is improperly written. It has been the practice of the Canadian National to return bill if all the references were incorrect.

W. O. Watkins (H. V.): The Hocking Valley has much the same reference as the Lehigh Valley and we have never had them object to any card where the billing was wrong, nor do I believe any other road objects to the rendering of the bill.

Enginehouse view on the Union Pacific at Cheyenne, Wyo.



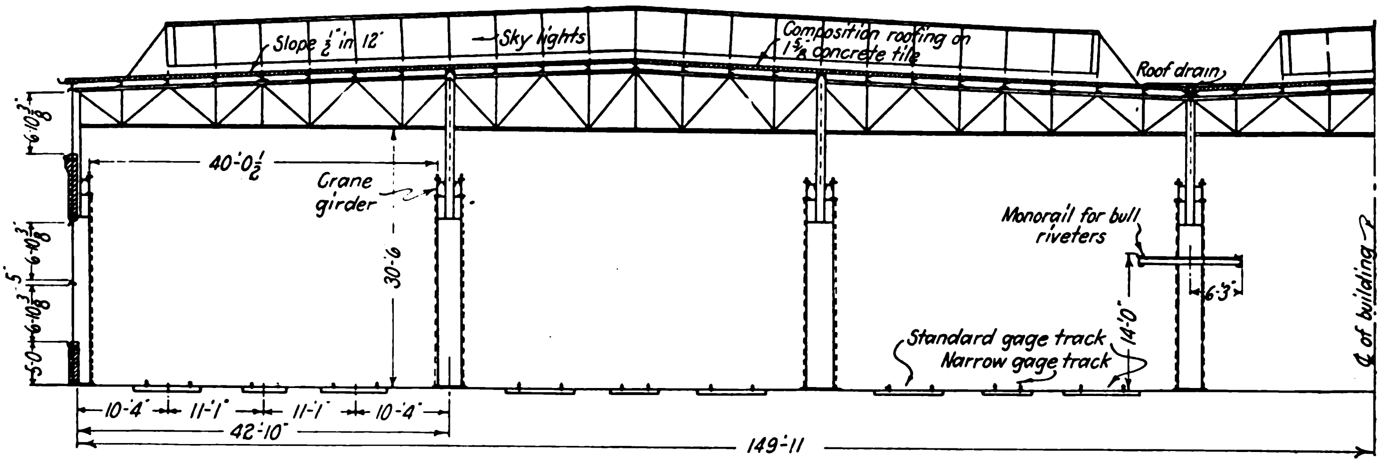
Steel underframe and trucks as received from the steel shop ready for application of wooden parts

E. J. & E. steel car shop at Joliet

Description of shop-method of organizing to rebuild twelve composite gondolas a day

FOLLOWING a fire in March, 1923, which entirely destroyed the steel car repair buildings of the Elgin, Joliet & Eastern at Joliet, Ill., this road erected a new steel car shop at Joliet featured by modern construction and equipment throughout, and with special provision for safe, sanitary and comfortable working conditions. This shop was designed primarily for the maintenance of various types of steel cars owned by the E. J. & E. but when it became necessary to re-build a series of heavy-duty drop-end composite gondolas as described in this article, arrangements were readily made, under the direction of J. Horrigan, superintendent of motive power, and C. H. Emerson, master car builder, to turn out twelve of these cars a day, the sills and other steel parts being fabricated in the steel shop and a station method developed on an outside track for handling the woodwork. Work in the steel shop was progressing on other all-steel cars simultaneously as they went through the various departments.

The new building is a brick and steel structure 300 ft. wide across the front and 500 ft. long on one side. Finding it impossible to extend the other side straight back owing to the cramped condition imposed by adjacent tracks, this wall is broken by two offsets which reduce the width of the building to 171 ft. across the extreme end. The building is 34 ft. high at the eaves. Six lines of steel columns extend lengthwise, as shown in the drawing, the columns in each line being 25 ft. apart and the lines spaced 42 ft. between centers. The effect of this arrangement is to divide the interior of the building into seven longitudinal bays with no partitions to obstruct the light or prevent ready communication throughout the floor area.



Cross-section through shop—Traveling crane and monorail runways indicated

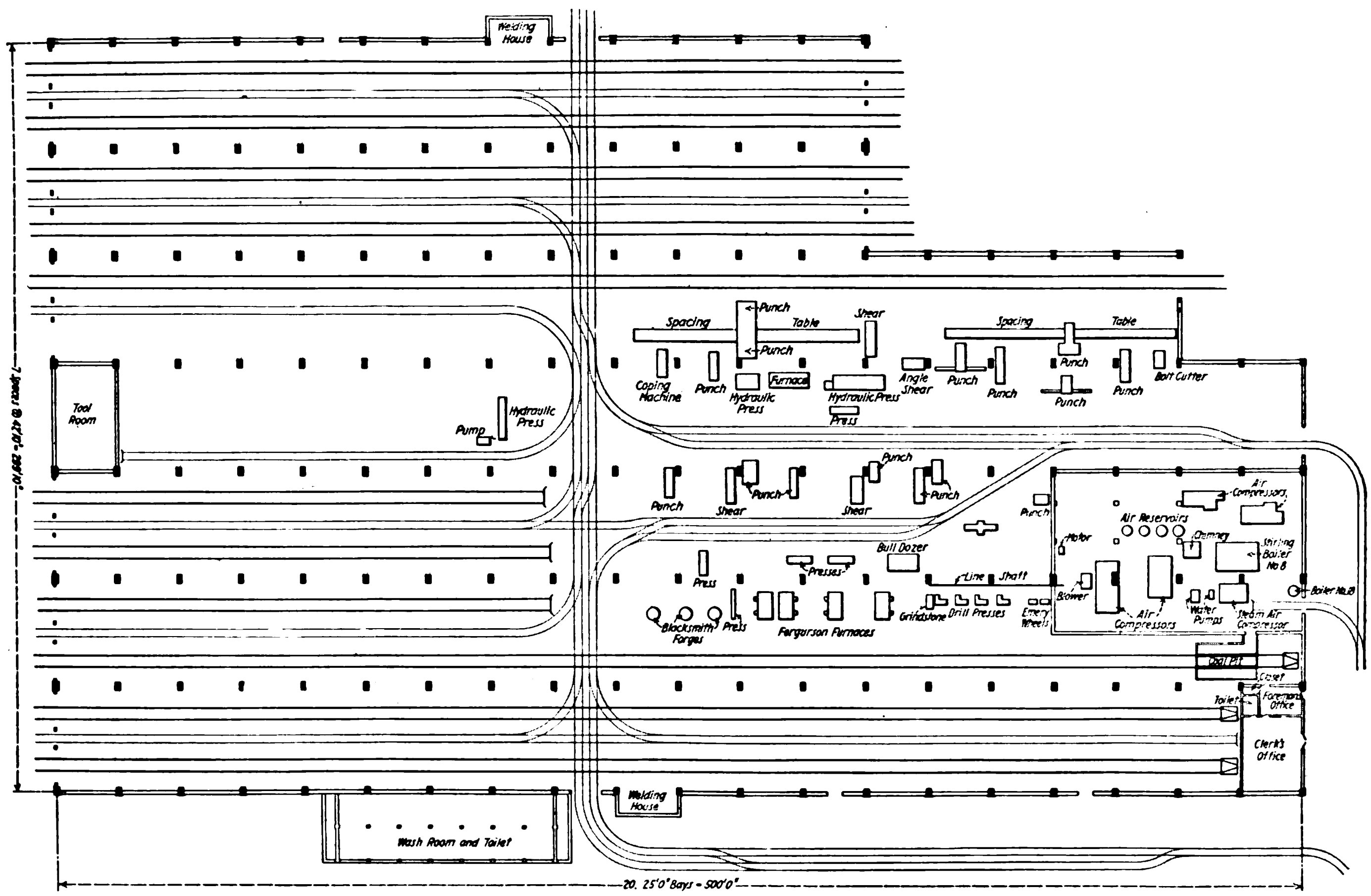
Ample light is afforded during the day by means of the large proportion of window area in the side walls and A-frame skylights which occur in three rows down the length of the building. The electric lighting system is also efficient, including 200-watt bracket lights on each side of each column, overhead lights of 300-watt in each bay, and numerous 60-watt drop lights. All wiring for

this lighting is carried in conduits and every light is equipped with a parabolic reflector.

Traveling cranes in all bays

The arrangement of these bays is such as to accommodate 11 standard gage tracks with a total capacity of 85 cars and seven narrow gage tracks. In the first two bays on the north side of the building, four tracks extend through the building to a ladder at the east end which permits ready connection with the switching and storage tracks in that vicinity. This arrangement also permits the repair of cars in successive stages which has been found to expedite production. The tracks are laid on 20-ft. centers which leaves room for a narrow gage track down the center of each bay between the standard gage tracks. Six-ton traveling cranes operate throughout the length of each bay on crane ways carried 25 ft. above the long. In the west half of the fifth and sixth bays are four standard gage tracks arranged with a narrow gage track in the center of each bay. The east half of the area, except for the boiler plant at the far end, is occupied by four oil furnaces, a number of forges and additional machinery, chiefly presses and punches. Each of the fifth and sixth bays, like the others, has two six-ton cranes. In addition, jib cranes are installed on a number of the columns to serve the big presses and punches in the vicinity. The seventh bay of the building is occupied throughout by two standard and one narrow gage track, except for the extreme east end where the shop office is located.

An important feature of the plant, aside from the large number of cranes, riveter runways and jib cranes, is the system of narrow gage track laid in the building. These tracks have already been described as extending between



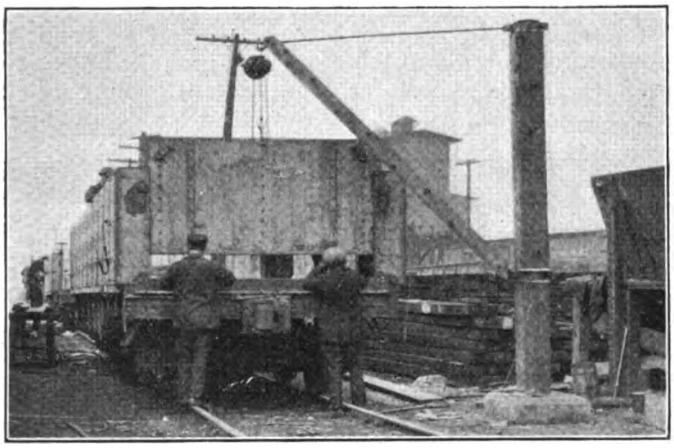
Drawing showing the location of the machine tools and track layout

top of the rail. Between the tracks at intervals of 40 ft. along the floor are two-way air cocks so arranged as to make it unnecessary to carry air hose across the track. The third and fourth bays are devoted chiefly to presses, shears, punches and other car repairing machinery, the location of which is shown in the drawing. Narrow gage tracks in this area serve a portion of the standard gage tracks and the machines. A toolroom is situated in the area in the forward end of the bays next to the west wall of the building. In addition to the six-ton crane the line of columns separating these bays carries runways for a collection of air-riveting machines. These runways are supported 6 ft. 3 in. from the columns on each side, 14 ft. above the floor, each serving five riveters, all of which are suspended from the runways by chain hoists.

The other three bays in the building are each 500 ft. all standard gage tracks and throughout the machine areas. Their main value, however, rises from the fact that they form an integral part of a system which extends all over the yards and also from the installation of two lines of this track crossing the building at the center with switches to all longitudinal tracks. This affords a connection between all tracks in the shop and facilitates communication with the areas outside the building. By means of an adequate number of electric tractors and trailers the economical handling of material throughout the plant is thus assured.

Special facilities have been provided for the workmen including principally a modern wash and locker room which is built adjacent to the south side of the building on the outside. This building is built 28 ft. wide and 100 ft. long. The first floor is equipped with individual

toilets and with washing facilities which include rows of double basins across the building in addition to basins along the wall, all of which are provided with spray faucets, while an upper floor is built for steel lockers and lunch room. There are 506 of these lockers, all installed on transverse tiers on concrete footings which serve also as seats. This building is well-lighted and ventilated and has concrete floors throughout. Two rows of drinking fountains extend through the main shop at intervals of about 120 ft. and three rows of urinals at

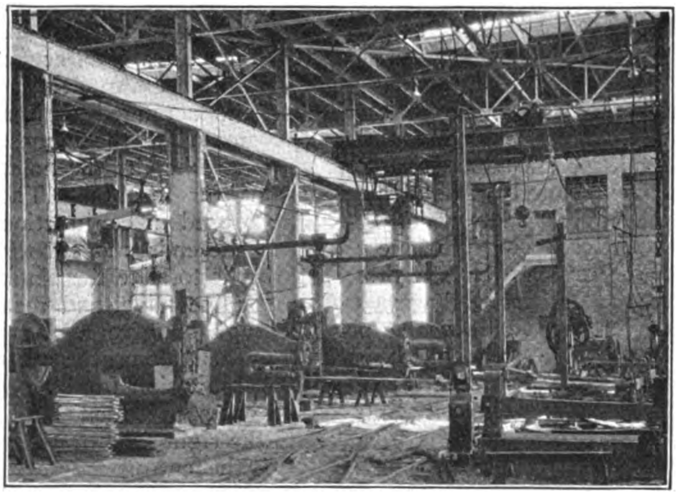


This jib crane located at a strategic point facilitates handling heavy end gates

intervals of 80 ft., the latter draining into sewer lines which also serve a collection of floor drains well distributed throughout the shop.

Another adjunct of the building is an offset 10 ft. wide and 30 ft. long added to the north and one to the south wall of the shop for electric welding work, it being the practice to move only the acetylene outfits from point to point in the shop.

No heating facilities are provided except for the office



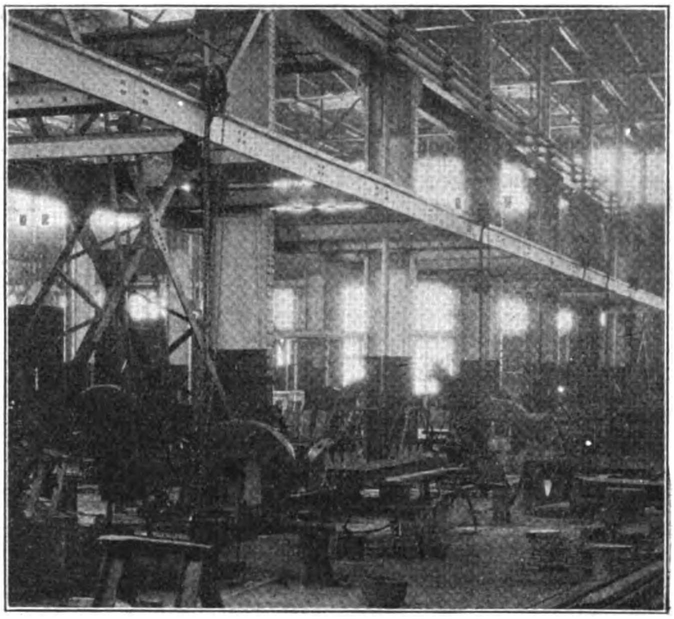
Car shop interior—View looking northeast, showing battery of punches

and for washing purposes. The boilers for this purpose, together with other power equipment, including four modern electrically-driven compound air compressors and heating boiler, are enclosed in a room in the east end of the building. This room includes an overhead platform for the electric transformers and is supplemented by a room provided above the office for repairing all electrical equipment. The machinery installed at this shop is shown in one of the drawings.

Organization for building composite gondolas

During 1924, 929 steel cars were given light repairs and 2,191 heavy repairs at the Joliet steel car shop. The men employed on this work averaged 514, the supervisory force consisting of one general foreman and nine foremen. When it became necessary to rebuild a series of 100,000 lb., drop-end, composite gondolas, arrangements were made to fabricate the new steel parts required on these cars in the steel shop and apply the decking, heavy wooden sides and reinforced end gates by the progressive system on an outside track adjacent to the steel car shop.

The location of the machinery in the steel shop is scientifically planned to provide straight movement of the long, heavy steel plates, channels, angles and other structural steel shapes through the shop with a minimum of handling and absence of back travel. The raw material comes into the third and fourth bays from the east end where it is cut to size, punched on automatic



View showing riveting yokes and runway

spacing machines and passed on to the west ends of the bays where portable pneumatic riveters, supported by chain hoists from monorails, are used by special gangs in performing the various assembling and riveting operations. The furnaces and hydraulic presses, shown in the drawing, are used for manufacturing the great quantity of pressed steel shapes used in the different types of steel cars.

In the composite gondolas under consideration, the steel work consists of built-up center, side and end sills, assembled, together with special reinforced end posts, to form a rugged steel frame for this car which must be strong enough to resist the severe service encountered in handling coal, steel billets, structural steel shapes and other heavy material from the mills. The organization for handling sill work consists of eight gangs, five gangs on center and side sills and three gangs on end sills. Each center and side sill gang, consisting of six car men, two car helpers, two rivet heaters and one car helper (supply), has a capacity to turn out nine center sills or ten side sills in an eight-hour day. Each end sill gang, consisting of three car men, one car helper and one rivet

heater, has a capacity of eight end sills in eight hours.

There are 24 assembling stations in the shop where 24 underframes are laid down. This work is divided into fitting frames and driving frames. The 12 frames which are laid down and fitted one day are driven and shipped the next. One fitting gang consists of five car men, and one driving gang consists of two car men, two car helpers and two rivet heaters. There are twelve of each of the above gangs required for the 24 stations which have an output of 12 finished underframes in eight hours.

When completed in the steel shop, the underframes with corner posts applied are loaded on flat cars and set on a track south of the shop. Here they are applied to trucks built up from new and reclaimed material which has been saved from the series of cars being rebuilt. The trucks and underframes then move to the track on which the wooden parts of the car are applied.

Station method used in applying wooden car parts

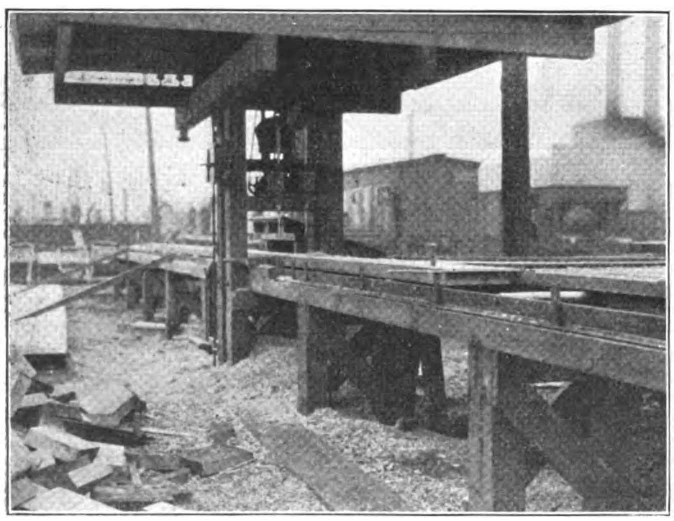
There are nine stations on a single track for the application of air brake equipment, deckings, sides, etc., and completing the car, two cars being worked on at the same time at each station. The gangs at each station are so organized and balanced that their work is completed at approximately the same time, and a move is made every 40 min., giving an output for the track of 12 cars a day.

At Station 1 the train line and air brake equipment are applied, two men working on the air cylinders and reservoirs and two other men applying the balance of this equipment. Stringers are also applied and nailed in place at this station by two gangs of four men each.

At Station 2 the riveting gang puts on all safety appliances, sill steps, grab irons, lift lever brackets and brake staff supports, the gang consisting of one car man, one helper and one rivet heater.

At Station 3 the couplers and side stakes are applied by a gang of eight car men.

At Station 4 the decking is applied by 12 car men.



Machine for boring holes in side plank and cutting them to length

At Station 5 the car sides are applied by one gang of eight car men.

At Station 6 the car sides are bolted in place by 16 car men.

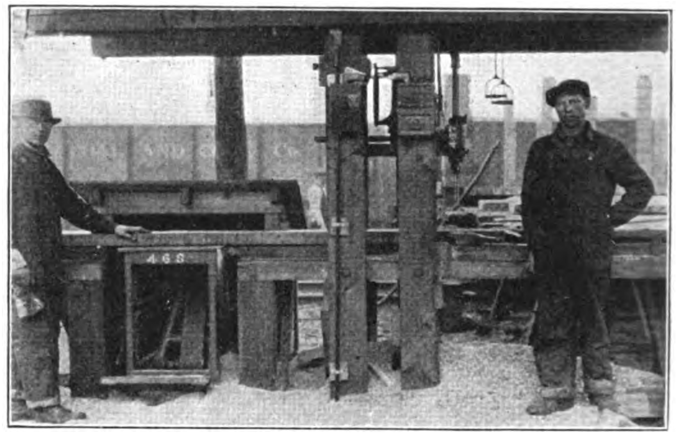
At Station 7 the end gates are made by six car men and applied by the same men who apply the car sides.

At Station 8 the decking is nailed by two men using pneumatic nailing machines.

At Station 9 the air brake is tested and the cars painted and stenciled.

The organization for handling the application of air brake equipment and wooden parts to these composite cars is notable for the smoothness with which it functions. Every effort is made to save unnecessary handling of material, and minimize the manual labor involved in that handling which is actually necessary. As a means to this end, woodworking machines, including cut-off saws, rip saws and boring machines, have been located as required at various points along the track with protection afforded against rainy and stormy weather.

For example, at Station 2 a special gang of five men handles and cuts off the 3-in. yellow pine decking; two men operate the rip saw for such pieces of decking as are not the right width; and two operate a boring machine,



Close-up view of machine for cutting off side planks

all of which are protected from the weather by means of a small shed. Several grooves must be cut the entire length of nine pieces of decking for each car to accommodate the nine tie rods which extend crosswise of the car. An ingenious arrangement, known as a "wabble" saw, enables this groove to be cut 1-in. wide by 7/8 in. deep, quickly and with only one pass over the machines.

The arrangement for machining and applying the 3-in. No. 1 Douglas fir side planks is exceptionally effective and clearly shown in two of the illustrations. An electric-driven, two-spindle boring machine is arranged with a table and rolls long enough to accommodate the longest plank and an automatic spacing device whereby the holes can be bored without measurement for location. The illustrations show a cut-off saw also used in conjunction with this boring machine to square the ends and cut the planks to length. The first operation is to slide the plank up the two inclined ways to the machine table, and then cut off one end of the plank enough to give a clean, square cut. The plank is then pushed along the rolls against a stop which gives the proper position for boring the first two holes. Subsequent holes are then bored rapidly as the plank is advanced to the right from position to position. At the final position, the cut-off saw cuts the plank to length, the plank then being slid on greased ways to a platform about three feet high between the machine and cars at Station 5.

An ingenious jib crane which assists in applying end gates is also shown in one of the illustrations. These gates are made by a gang of six men on a platform shown at the right in the illustration. The planks, cut to the right length, are shipped to this platform and the work consists of boring them with pneumatic drilling machines in accordance with holes in the steel sheets with which they are reinforced. The planks are then bolted in place and by means of the jib crane and differential chain

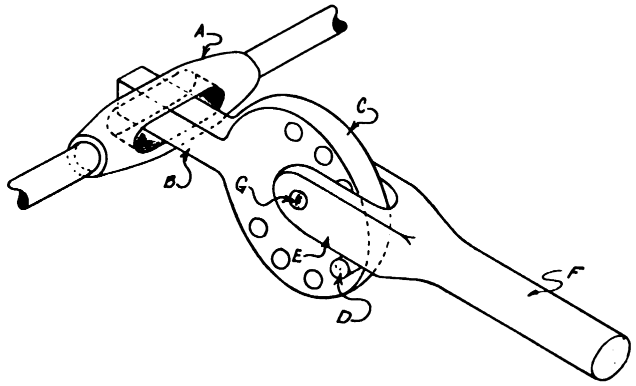
hoist illustrated, they are readily swung into place on the car. This gang of six men turns out 24 end gates in eight hours.

Aside from the new shop facilities at Joliet, careful attention to details in handling material and proper balancing of the gangs have been mostly responsible for the effective manner in which these E. J. & E. 100,000-lb. composite gondolas are being rebuilt.

Wrench for tightening turnbuckles

THE wrench shown in the drawing is used at the Waycross, Ga., shops of the Atlantic Coast Line for tightening turnbuckles on the truss rods of passenger cars, where equipment boxes, water tanks and other apparatus interfere with the free use of a straight bar.

The tongue, *B* is 1½ in. square and 7 in. long, forged in one piece with the 9-in. disc, *C*. The yoke *E* has sides ¾ in. by 3 in., with a depth of 6 in. The handle *F* is 1¾ in. in diameter and 10 in. long, forged in one piece



Wrench for tightening truss rods on passenger cars

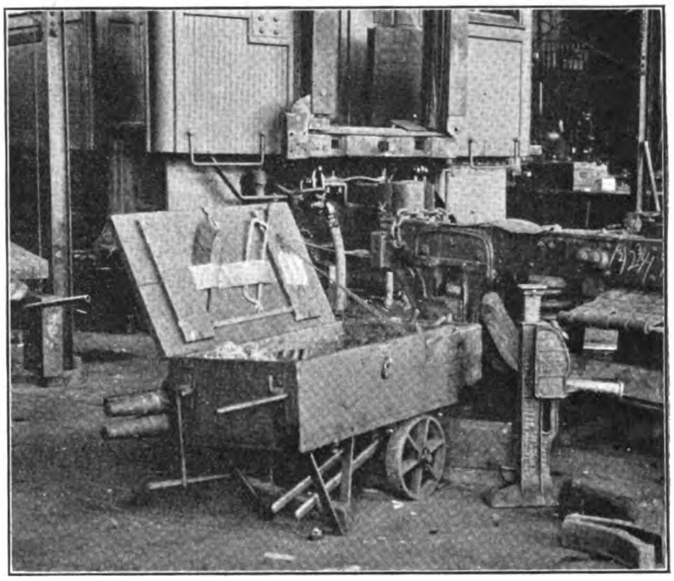
with the yoke. A piece of 2-in. pipe may be used for an extension to this handle when desired.

The disc is drilled at the center and fastened to the yoke with a 1-in. pin, *G*. Eight 1 1/16-in. holes are drilled in the disc as shown. A 1-in. pin, *D*, is inserted in a hole either above or below the yoke according to the direction the turnbuckle is to be turned. This provides a rigid wrench with the handle at a convenient angle so that a man may operate it to the best advantage. The description of this wrench was obtained through the courtesy of the Atlantic Coast Line News.

Car repairmen's portable tool box

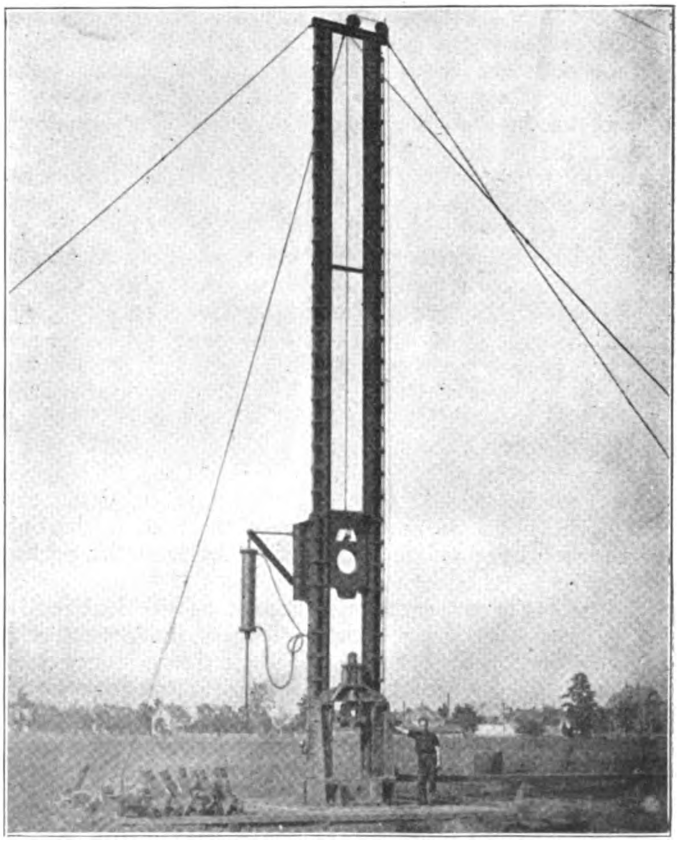
IN some car shops it is the practice for the workmen to keep their tools in a bench drawer or locker. This means that every morning the workmen have to get their tools out and carry them to the job and in the evening gather them up and put them away for the night. Thus, considerable time is lost before the men are ready to start work, to say nothing of tools becoming lost or stolen, owing to the fact that the tools are scattered all around the car on which they are working.

This condition is particularly true where the work is specialized and one gang goes all over the shop, i.e., a truck gang. The tool wagon shown in the illustration is used by a truck gang in a passenger car repair shop. The wagon is fully equipped to repair trucks. The main box contains the larger and most valuable tools. At the front end is attached a small box in which are kept drifts, chisels and other odds and ends used on the job. Two large wooden jack handles are carried on the side of the box in two leather straps. Beneath the box are carried large single end wrenches. Two Duff jacks are carried in the box. The handles of the wagon are so constructed that when they are not in use, they hang out of the way

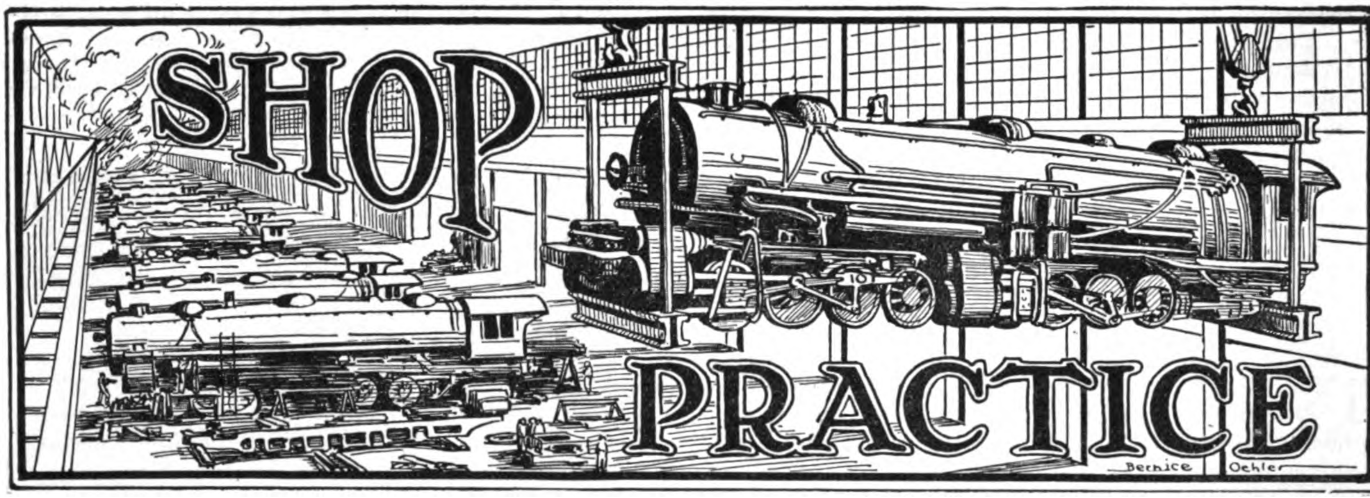


Portable tool box used by a car truck repair gang

perpendicular to the floor. At the end of the day, the tools can be quickly gathered up and placed in the box which is locked and left standing by the job until the next morning.



Drop test machine presented in 1900 to Purdue University by the Master Car Builders' Association



Inspection of flexible staybolts*

By E. S. Fitz Simmons
Sales Manager, Flannery Bolt Company, Pittsburgh, Pa.

THE development of the flexible staybolt, in this country, dates back to about 1890 and early experimentation was stimulated by the enormous number of breakages which occurred in the rigid type of staybolt. Probably the first type of flexible staybolt which could be readily inspected without removal was one of the round headed design, using a sleeve and removable cap, which was designed by John B. Tate of the Pennsylvania Railroad and introduced by the Flannery Bolt Company about 1904. This design gave promise of eliminating many of the weaknesses of former types and provided a means, though an expensive one, of ascertaining the condition of the bolt without removing it from the boiler. For these reasons it was quite generally tried out by many railroads and the results obtained were so satisfactory that its adoption and general use almost immediately followed.

In 1905 a Committee of the American Railway Asociation reporting on flexible staybolts said of it: "Though of comparatively recent date, it has been received with great favor, indicating the rapidity with which a new bolt of promising design is given a practical trial in the effort to cure the staybolt trouble." Further in this same report the committee stated the following: "A simple means of positively detecting cracked and broken bolts is an improvement needed by all flexible bolts that are in service at the present time. The removable of the cap, which will allow an examination of the bolt, is the only absolute means possible with flexible bolts of the present design."

In 1911 the act commonly known as the Locomotive Boiler Inspection Law became effective, under authority of which, rules requiring among other things the removal of caps from flexible staybolts for inspection purposes at special stated intervals, were promulgated and enforced.

The generally satisfactory service rendered and the very small percentage of breakage to total number in service (this type having become practically standard) created a doubt in the minds of many railroad mechanical officers of the justification of such a rule or requirement and it was quite generally, and for a time quite strenuously, opposed. However, the Locomotive Inspection Bureau, through its corps of inspectors, had indisputable evidence of the necessity for thorough and regular inspection, for while it was admitted that the percentage of breakage to the total number in service was small, it was shown beyond question of doubt that in certain instances breakage did occur to such an extent as to become a menace to life and property.

Investigations were begun to determine the cause of breakage in an endeavor to apply a remedy. A number of investigations confirmed the absolute necessity for careful and frequent inspections and also clearly demonstrated the need of a more accurate and positive method of test than the mere removal of the caps and an examination of the bolt heads.

Instances were found where, under bad water conditions, accumulations of scale between the body of the bolt and the inner wall of the sleeve were such as to solidly lock the bolt in the sleeve. The result was to render ineffectual the flexible feature and to cause the bolt to break at the fire box sheet.

During the past ten years, and more diligently during the past five years, after these abnormal conditions had been prominently developed, constant effort has been made to perfect a method of inspection that would provide greater safety and insure against loss of life, injury to persons, and damage to property.

The first actual service test of such a method was made in August 1920 on large Mallet type locomotives where abnormal conditions existed and where breakage of flexible bolts was excessive. This method consisted of the installation of flexible bolts with telltale holes extending from the firebox end entirely through the body section and terminating within the bolt head, and the testing of these bolts at regular intervals with a specially constructed instrument to determine definitely that the telltale holes were open and, therefore, operative throughout their entire length. This was accomplished by so constructing the instrument that an electrical circuit would be established when contact was made at the end of telltale hole.

During this service test, two distinct features were developed:

*Abstract of a paper presented at a meeting of the Southern Railway Club, Atlanta, Ga., September 17, 1925.

First—that moisture, due to temperature changes, condensed in the telltale hole and formed rust or iron oxide which gradually increased to such an extent as to interfere with the insertion of the testing instrument. In seeking a remedy for this condition, various methods were tried, the most satisfactory and the one at present in use being the electro-plating of the walls of the telltale hole with copper. Four years experimental work and service tests have demonstrated the complete success of eliminating the difficulty by this method.

Second—that cinder and other foreign matter accumulated in the telltale holes to such an extent as to require excessive labor to dislodge and remove it in order to permit the insertion of the testing instrument. The cost and time required for this made the method impractical. After numerous experiments it was found that a closure of fire-proof porous material applied in the end of the telltal hole prevented the accumulation and at the same time permitted leakage of steam or water in case of fracture, and that it was also readily and cheaply removable to allow insertion of the testing instrument.

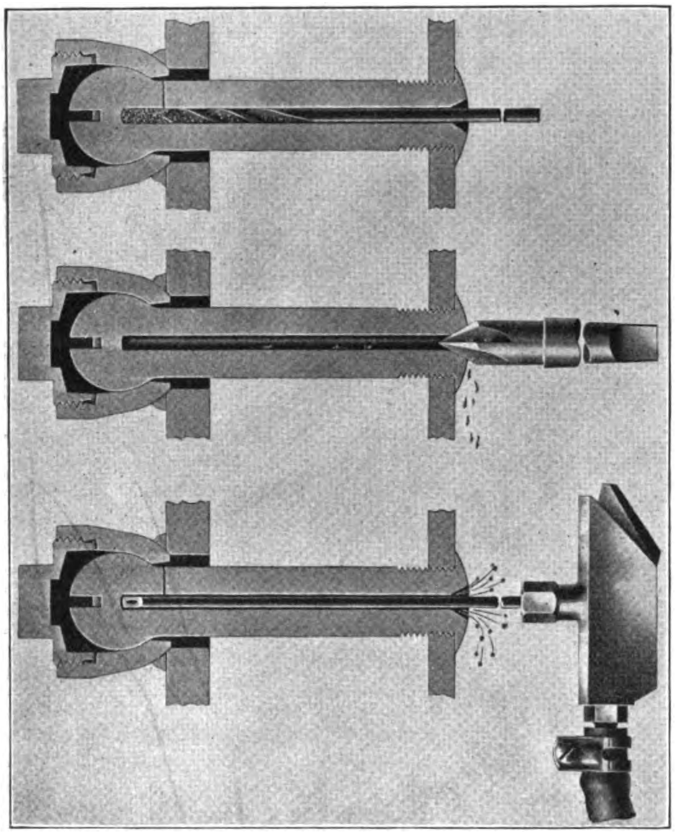


Fig. 1—Cleaning out the telltale hole by means of special air tool

Application of telltale flexible staybolts

The telltale flexible bolt is identically the same as the Tate bolt with the addition of a telltale hole extending through the entire length of the body section and terminating within the head of the bolt. The walls of the telltale hole are copper plated to prevent rust or corrosion within the hole and to prevent them from becoming closed from this cause.

They are applied exactly the same as the ordinary flexible bolt. If the method of riveting closes the end of the hole, it may easily and quickly be re-opened, after which a porous fireproof closure is applied that will prevent the accumulation of foreign matter from entering the telltale hole and that will permit leakage of steam or water in case of a break or fracture, which serves as a daily indicator of the condition of the bolt.

Inspection of telltale flexible staybolts

In addition to depending on the leakage through the telltale hole, an inexpensive method of periodically checking up the condition of the telltale hole is provided as follows:

The fireproof porous closure is first removed, after which the specially constructed testing instrument is inserted. Upon reaching the extreme end of the telltale hole and making contact therewith, a light flashes in the handle of the tester indicating that the hole is open and therefore operative throughout its entire length.

The method of testing has been built upon the fact that a broken bolt having a telltale hole will show leakage of water or steam, providing the telltale hole is open and operative and that it extends to every breakable part of the bolt.

The tester is so designed and constructed that it will positively indicate whether or not the telltale holes are open throughout their entire length. After inserting the tester in each telltale hole and securing light in the handle (which indicates that contact has been made with the extreme inner end of the hole) if the bolt is broken, or fractured into the hole, leakage will positively occur when water pressure is applied to the boiler.

Use of the tester

First, with a sharp pointed pin or punch and a light hammer, break through the porous closure; then blow all of the remaining particles out of the telltale hole with the air tool—shown in Fig. 1. Attach the ground connection in any convenient telltale hole, then insert the tester rod into each telltale hole until contact with the end of each hole is secured. Such contact is indicated by the lighting of the bulb in the tester handle, as shown in Fig. 2. After contact has been secured in every bolt, apply water pressure to the boiler and every defective bolt will be indicated by leakage through the telltale hole. If no defective bolts are found, or after replacing any that are found, again close the telltale hole with the fireproof porous material and the locomotive is ready for service.

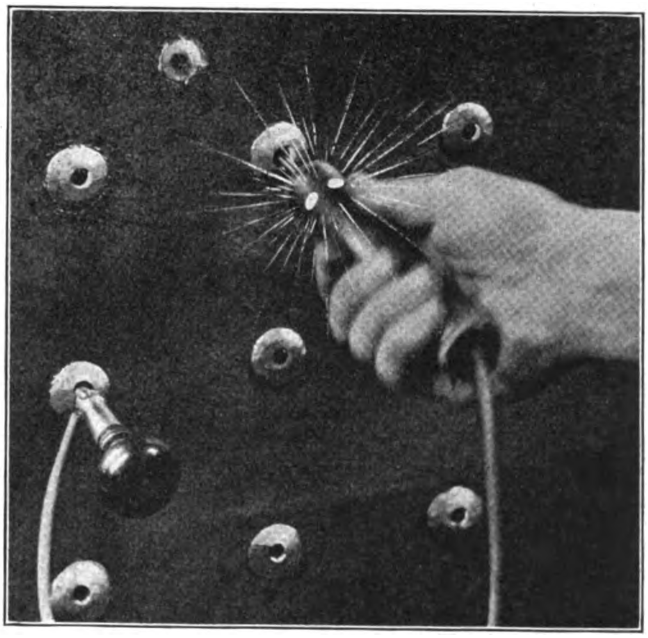


Fig. 2—A light in the tester handle indicates that the telltale hole is open the full length

Cases may occur where breakage or fracture will be

indicated by leakage and will not be observed or detected at the time they develop, as for instance bolts in locomotives in pusher service at isolated points or bolts located behind brick arches, grate bars, etc, and in which the telltale hole will gradually become filled by accumulation of scale from the boiler water. Therefore, whenever the tester is inserted, it strikes an obstruction and fails to show a light in the handle, as is shown in Fig. 3. In such cases the tester should be removed and a special cleaning drill applied to remove the obstruction. After drilling, blow clean with the air tool such as was shown in Fig. 1, re-insert the tester, and if the hole has been thoroughly cleaned, contact will be secured and indicated by the lighting of the bulb as before described and when water pressure is applied, leakage will occur.

Bear in mind that securing contact in the telltale hole does not indicate that the bolt is in good condition, but only that the telltale hole is open and operative throughout its entire length. It is the failure of the bolt to leak under pressure after contact has been obtained which indicates that it is not broken.

The present method of inspection requires from three to four or more days, the principal part of the work being the removal and replacement of parts, rather than the actual time required by the inspector to examine the bolts.

By the new method herein described, it is not necessary to touch or remove anything on the outside of the boiler and the entire test on a modern locomotive boiler containing a full installation of flexible bolts can be completed within an eight-hour day—and at a labor cost of from $10 to $20, depending on the size of each respective installation.

The cost to strip, remove caps, inspect, and replace runs

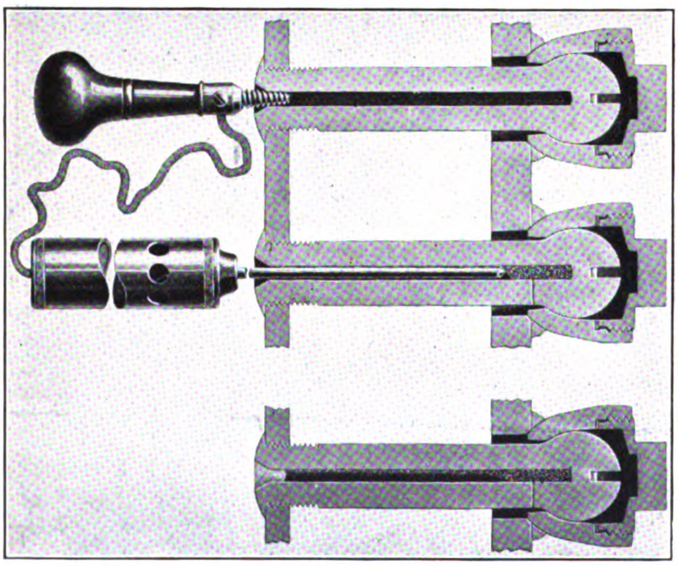


Fig. 3—An obstruction in the telltale hole prevents the tester rod from making contact. This condition is indicated by the failure of test lamp to light

from $100 to $250, depending upon the size of the locomotive and upon the facilities at hand, and in addition, results in two, three, and sometimes more, days loss of engine service.

The principal advantages of the new method of inspection are: Greater safety by constant daily indication of bolt conditions; material reduction in maintenance costs by reason of eliminating a vast amount of labor now required under the older method of inspection, and a substantial saving in locomotive service by reason of being able to make inspection by the new method at the time of the regular annual hydrostatic test and without additional loss of locomotive service.

A number of railroads have been using the new method of inspection just described for some time, irrespective of the fact that the Government had not yet approved it, because they were convinced that it added such an immeasurably increased factor of safety that it would more than compensate for the additional cost of this method of testing in addition to complying with the Interstate Commerce Commission rules that require the removal of caps every two years. The Locomotion Inspection Bureau, however, has been fully aware of the use of this new method for the last four or five years, has been checking

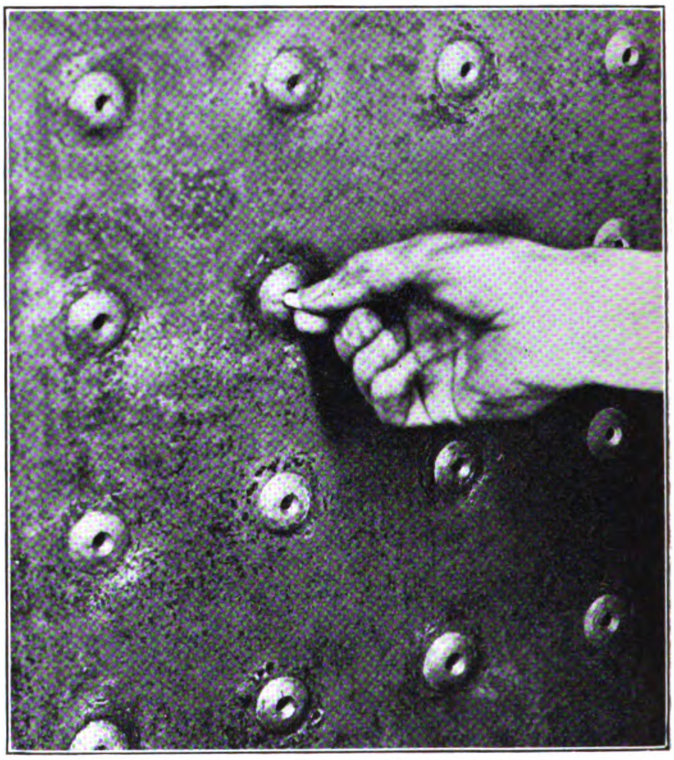


Fig. 4—Applying the porous closure to telltale hole after inspection

up the results carefully, and when a number of the railroads that have been using this method of inspection for some time made an application for a modification of Rule 23, careful consideration was given with the result that, at a general session of the Interstate Commerce Commission held at its office in Washington on July 26, 1925, it was ordered that Rule 23, as approved in the order of the Commission entered April 7, 1919, be, and the same is hereby amended to read as follows:

23. *Method of testing flexible staybolts with caps.*

Except as provided in paragraph (b), all staybolts having caps over the outer ends shall have the caps removed at least once every two years and the bolts and sleeves examined for breakage. Each time the hydrostatic test is applied, the hammer test required by rules 21 and 22 shall be made while the boiler is under hydrostatic pressure not less than the allowed working pressure.

(b) When all flexible staybolts with which any boiler is equipped are provided with a telltale hole not less than 3/16 in. nor more than 7/32 in. in diameter, extending the entire length of the bolt and into the head not less than one-third of its diameter and these holes are protected from becoming closed by rust and corrosion by copper plating or other approved method, and are opened and tested, each time the hydrostatic test is applied, with an electrical or other instrument approved by the Bureau of Locomotive Inspection, that will positively indicate when the telltale holes are open their entire length, the caps will not be required to be removed. When this test is completed, the hydrostatic test must be applied and all staybolts removed which show leakage through the telltale holes.

The inner ends of the telltale holes must be kept closed with a fireproof porous material that will exclude foreign matter and permit leakage of steam or water, if the bolt is broken or fractured, into the telltale hole. When this test is completed, the ends of the telltale holes shall be closed with material of different color than that removed and a record kept of colors used.

(c) The removal of flexible staybolt caps and other tests shall be reported on the report of inspection Form No. 3, and a proper record kept in the office of the railroad company of the inspections and tests made.

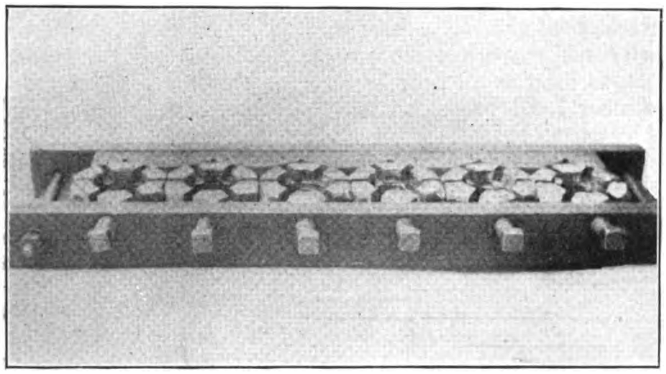
(d) Fire box sheets must be carefully examined at least once every month for mud burn, bulging, and broken staybolts.

(e) Staybolt caps shall be removed or any of the above tests made whenever the United States inspector or the railroad company's inspector considers it desirable in order to thoroughly determine the condition of staybolts or staybolt sleeves.

Effective shop jigs and devices

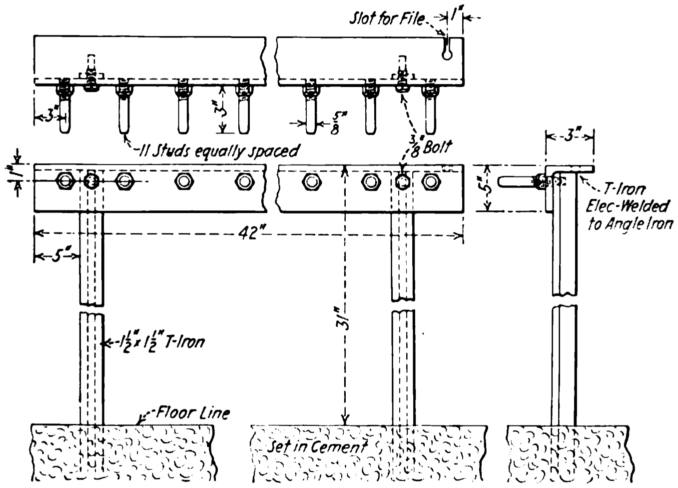
American Railway Tool Foremen's committee report on the subject calls attention to many shop devices of value

One of the features of the American Railway Tool Foremen's convention, held at Chicago, September 2 to 4, was the report on jigs and devices for locomotive and car shops, read by Chairman Henry Otto,



Jig used in cutting slots for castle nuts

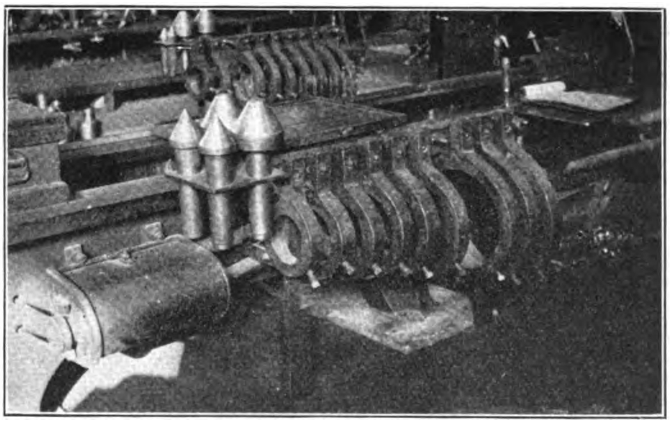
tool foreman of the Atchison, Topeka & Santa Fe at Topeka, Kan. An imposing aggregation of photographs and blue prints of labor-saving shop devices were dis-



Rack for holding lathe dogs or drivers at crank pin and axle lathe

tributed for the examination of members of the association and posted around the walls of the convention hall. Some of these have already been described in previous issues of the *Railway Mechanical Engineer* and a selected list of eight others are illustrated in the following article. As mentioned on the floor of the convention the committee expressed its appreciation for help in collecting data and photographs of many of the shop kinks to J. R. Phelps, shop apprentice instructor of the Atchison, Topeka & Santa Fe at San Bernardino, Cal.

Cutting slots in castle nuts—The illustration shows a device for cutting slots in castle nuts of sizes that are not carried in regular stock. The device is easily made of a scrap driving box shoe in which a strip is placed on one side, machined to fit the corners of six or more nuts and provided with a corresponding number of set screws on the other side to hold the nuts tightly in the jig while slots



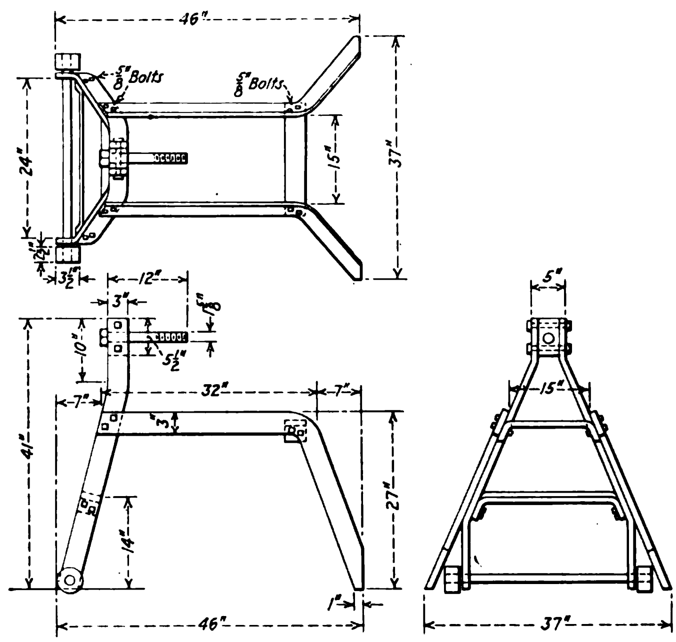
Rack for lathe dogs and centers

are being cut. The set screws are pointed downward at an angle of 5 deg. to offset any tendency of the nuts to work up under the action of the milling cutter. By having the machine operator turn the nuts as fast as they pass under the cutter, when one complete cut has been finished everything is in readiness for the next cut and there is no lost time in setting up. It will be noted that the sides of the shoe are tied together by two ⅝-in. bolts to give the jig added rigidity and prevent either side of the shoe breaking off, as might happen particularly if made of cast iron.

Rack for holding lathe dogs—Two racks for holding lathe dogs and lathe centers are illustrated. It will be readily seen that by the use of these racks the lathe dogs or drivers are kept off the floor and out of the way, at the same time being within convenient reach of the lathe operator when needed. There is less liability of the dogs being lost or damaged and, moreover, this arrangement favors the sweeper who does not have to move them about

from one place to another in attempting to sweep the floor.

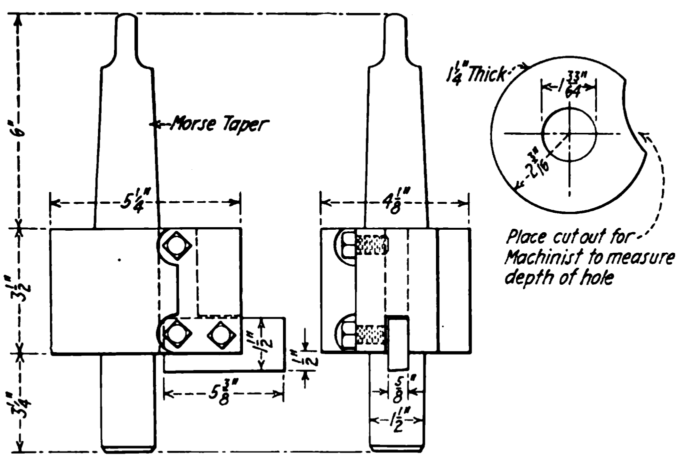
These racks are also used for holding lathe centers. One of the most important things about a lathe is its centers and by keeping the extra centers out in plain view, as illustrated, they are not so likely to be damaged as would be the case if thrown in a drawer with other tools or possibly left on the floor. Moreover, the machinist or foreman can at all times see the condition of the lathe



Rack for holding back chamber head while being worked on

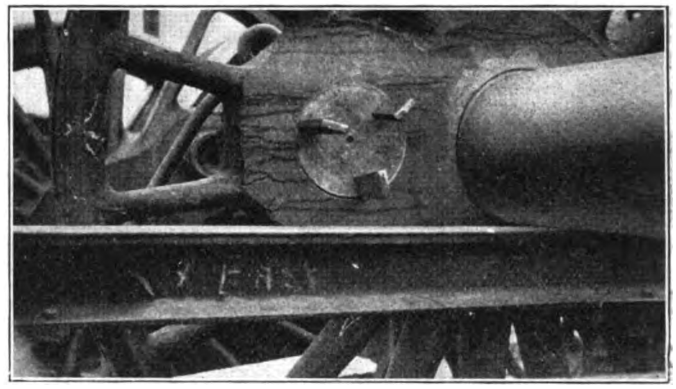
centers and this arrangement eliminates any possibility of the last extra lathe center being damaged and causing delay to an important job while it is being annealed and re-trued.

Valve chamber head rack—The back valve chamber head with its integral guides for the valve crosshead is a



Tool for facing the stuffing box of back valve chamber heads

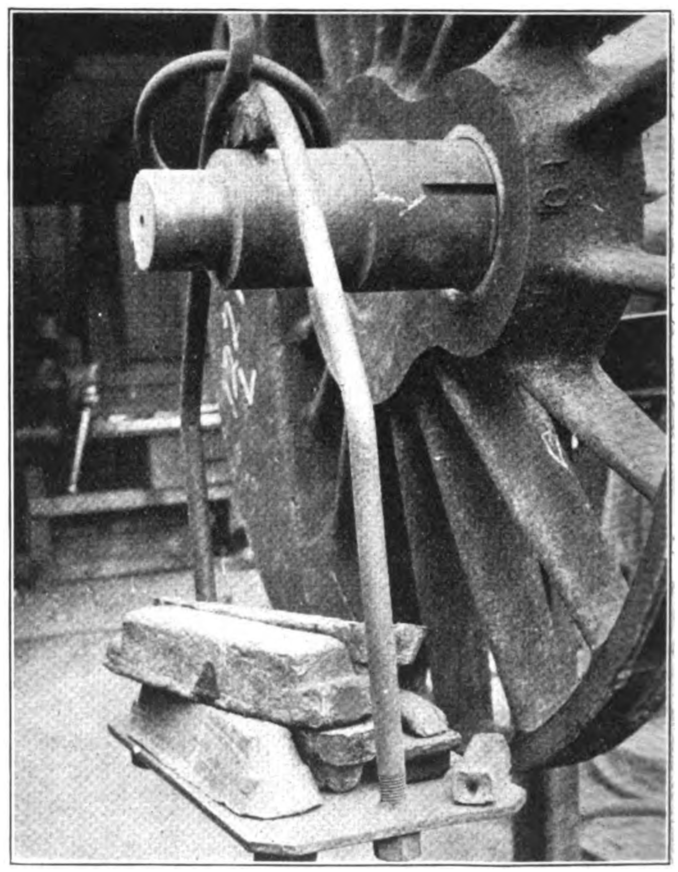
complicated casting of considerable weight which is extremely awkward to handle at the bench. A simple but convenient rack for holding any size of back valve chamber head while being worked on, is illustrated. This rack consists of a built-up framework of 1-in. by 3-in. bar iron bolted together and supporting at the top a horizontal holding bolt, 1⅝ in. by 10 in., to be inserted in the stuffing box hole in the valve chamber head. By means of suitable washers and a nut the head can be drawn up against the framework and held firmly at any angle required for the most convenient performance of the particular job at hand. The distance of the horizontal holding bolt above the floor is such as to bring the back head at approximately bench height. It will be noted that two legs of the rack are provided with small wheels so that by



Three taper keys hold temporary crank pin in place

lifting the other two legs one man can readily move the rack across the shop floor and yet it will not move too easily while work is in progress on the valve chamber head as long as all four legs are on the floor. Back valve chamber head work can be performed better, easier, and in less time by the use of this rack.

Facing stuffing box holes—A tool for facing the stuf-

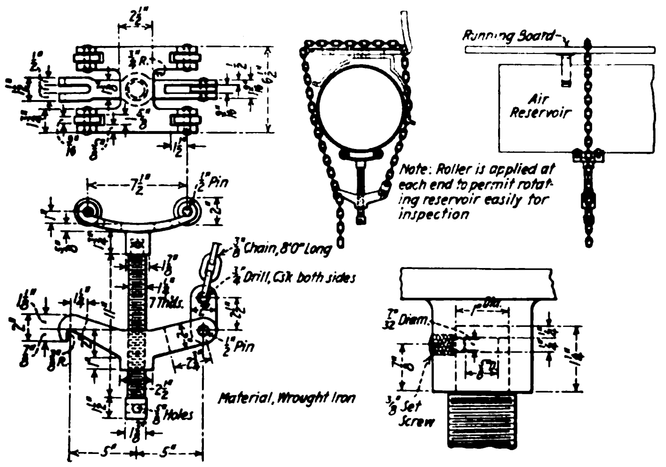


Temporary crank pin for use in quartering driving wheels

fing box holes in back valve chamber heads is shown in one of the drawings. Formerly this job had to be done on a horizontal boring bar often over-crowded with other work. With the tools shown, the facing operation can be performed complete on any heavy duty drill press, the

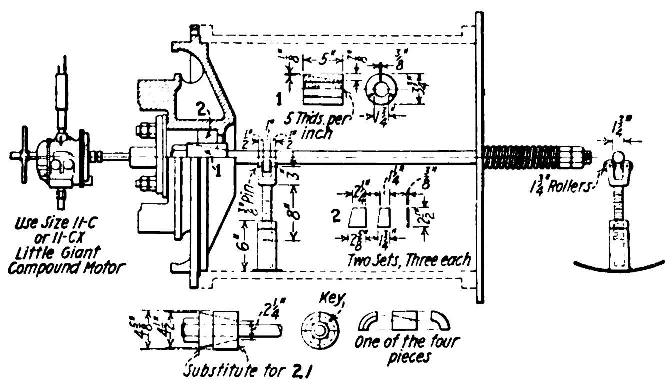
drilling, boring and facing operations all being done at one set-up of the back valve chamber head. The amount of metal to be removed and the width of the cut make it necessary that the pilot of the tool be guided by the block shown. The pilot is turned to 4⅜ in. in diameter so that it just fits in the bore of the stuffing box. The segment cut out is to enable the machinist to measure to the bottom of the hole and face off the stuffing box enough to secure the proper depth.

Temporary crank pins—A good start is often gained in fitting up a pair of new main driving wheels if the wheels can be weighed and counterbalanced and this work fin-



Rollers for testing main air reservoirs on locomotives

ished before the crank pins are made and pressed in. The illustrations show an arrangement whereby temporary crank pins with crank arms (if any) can be quickly applied and used in counterbalancing. Three tapered keyways are milled or planed in each of a pair of scrap crank pins taken from the same class of locomotive as the one for which the new wheels are being made. These keyways are ⅝ in. wide and take tapered keys 19/32 in. thick by 9 in. long and having a taper corresponding to



Cylinder head supporter

that in the crank pin. A taper of 1⅛ in. in 12-in. has been found to give good results.

The temporary crank pins are an advantage in practice when a pair of driving wheels is due to be weighed and for some reason the main pins are not ready; or possibly the tires must be put on and then after the crank pins are finally applied and the wheels put on the weighing rack with the proper weights hung on the pins, it develops that the tires must be taken off again to get the necessary lead into or out of the counterweight pocket. This is very likely to happen on an engine that has not been previously weighed and brought up to standard. With the temporary crank pin arrangement the wheels can be weighed and the tires put on to stay, whether the main crank pins are ready or not. Key-ways should be cut in two old scrap pins for each class of engine on which much weighing is done. The eccentric crank should be in position when the weighing is done; it being left off in the illustration in order to give a clearer picture.

Main reservoir rollers—A convenient arrangement for use when testing main air reservoirs on locomotives is shown in one of the drawings. The particular advantage of this device is that it enables the reservoir to be thoroughly tested without taking it down from the locomotive. The principle of operation is evident from the drawing, a chain and bracket with four rollers, rolls simply being applied around the running board and under each end of the reservoir. All pipe connections are broken and the reservoir clamps loosened. By tightening the screw underneath the rollers the weight of the reservoir is taken off the clamps and is supported on the rollers. The reservoir can then be revolved slowly for the hammer test with the assurance that every part of it will be thoroughly examined and tested.

Cylinder head supporter—The necessity of grinding back cylinder heads to a joint on the cylinders is generally admitted and as these heads carry the guide blocks and are heavy, the supporter shown in the illustration will be found useful in taking the weight off the cylinder counterbore and permitting the cylinder head to turn more easily. The supporter consists simply of a pair of 1¾-in. rollers set one at each end of a forked rod threaded into a sleeve and provided with a lock nut. The tension of the cylinder head against the cylinder is adjusted by means of the spiral spring and nut on the end of the center rod. A compound pneumatic motor is used to revolve the cylinder head during the grinding operation.

Drawbars and pins*

By James T. McSweeney,
Master blacksmith, Baltimore & Ohio, Garrett, Ind.

ON the Baltimore & Ohio drawbars and pins are made of steel billets or rolled steel bar at a workable heat. The holes are drilled in the ends. By this method we get a better bearing on the pins. If there is to be an oblong hole in the drawbar ends, such holes are slotted and not cut out with torch. The purpose of having an oblong hole in the drawbar is to relieve the shock on the pin when coupling on to a train.

No holes in the drawbars are required. When the holes are found to be worn to ¼ in. diameter larger than the original size, the bar is scrapped and the material is used for some other purpose. Drawbars and pins are removed and carefully examined every three months for possible defects. When the locomotives are undergoing classified repairs, the drawbars are removed and heated to a cherry red, given a thorough examination for defects while hot and are then allowed to cool slowly in a dry place, free from dampness or drafts. The welding of drawbars either in the blacksmith shop or by the autogenous method is not permitted.

Drawbar pins are made from rolled steel bar stock and used without turning. In my experience I find that pins made from bar stock and not turned, give the best wear. If the pins are turned, they should be annealed before being placed in service. This makes the pin tougher and it will withstand wear longer.

*Abstract of paper presented at the twenty-ninth annual convention of the International Railroad Master Blacksmith's Association, Cleveland, Ohio, August 18-20, 1925.

The importance of the toolroom to the railroads*

Some ways in which it can be operated to help reduce shop and enginehouse costs

By E. L. Woodward
Western Editor, Railway Mechanical Engineer

The importance and necessity of an efficiently organized toolroom in any railroad shop or enginehouse where a real attempt is being made to cut costs is self evident. The toolroom began to be an important factor in transportation with the first locomotive which was built. It is said that in 1829, before going ahead with his plans for the construction of the Rocket, George Stephenson was compelled to make a small, hand-operated engine lathe with which to fashion some of the locomotive parts. Presumably he also made the tools used in connection with the engine lathe and therefore fulfilled all three functions of locomotive designer, builder, and toolmaker. Since 1829 the toolroom has developed and now plays its full part as one of the vital departments of every railroad shop and enginehouse of consequence in the country. It may well be likened to the heart of the locomotive or car repair shop for from it flow the tools without which no other shop department can operate efficiently.

The motto of the American Railway Tool Foremen's Association, "For Greater Efficiency in the Railway Tool Service," is most happily selected, particularly the word service. It is not only the function of the tool foreman and his organization to provide necessary tools required for the various operations in repairing cars and locomotives, but it is doubly important that these tools be provided *when* needed, *where* needed, and in good working condition. In other words, the main object of the toolroom should be to provide real tool service to help eliminate as far as possible every lost moment, unnecessary step, and ineffective movement of the mechanics, repair men, helpers, and other employees in railroad shops and enginehouses.

There never was a time when this improved quality of tool service was more needed than at present. In June, 1925, 518,003 men were employed on maintenance of equipment work and receiving a compensation of $66,-228,792. The money which can be saved or wasted depending upon the kind of tools furnished these men can be readily appreciated. This is the opportunity, as well as the responsibility, of railway tool foremen.

There are many essentials to the provision of adequate tool service but these can probably almost all be summed up under one of the three heads (1) effective personnel organization, (2) up-to-date methods of handling the work and (3) toolroom equipment to meet modern needs.

System tool organization needed

As in all shop departments, the most important problem connected with toolrooms is one of supervision. Unquestionably those roads which have created the position of general supervisor of tools, and appointed a competent tool foreman to perform the duties of this position for the entire system have found the investment profitable. A railroad makes or saves money as a unit. Locomotives and cars are standardized for the system as are also shop practices to a considerable extent. Railway tools and toolroom practices must also be standardized for the system, for maximum economy, and practically the only way the managements can be sure of accomplishing this is by appointing an experienced man to devote his whole time to the work of general supervision. If some roads are too small to warrant the appointment of a general supervisor of tools some method must be devolved of co-ordinating the ideas of the respective tool foremen at individual points, otherwise there will be as many different types of special and commercial tools ordered and used as there are foremen. Some of these tools will be less efficient than others and an excessive number of repair parts must be carried in stock to keep them in operation.

Next to a general tool supervisor who can develop system standards of railway tools and toolroom methods, experienced local foremen and toolroom employees are required, for upon the accuracy and skill of their work depends in large measure the efficiency of the shop or enginehouse at which they are located. It is hardly necessary to point out to the members of this association the advisability of attracting to the toolroom as capable men as possible, training and developing them, and making their working conditions as attractive as possible in order that they may stay on the job and not necessitate the frequent breaking in of new men. The question of wages and general working conditions is not for the tool foreman to decide but it is in his power to make his men like their jobs or, on the other hand, begrudge every hour they have to spend in the toolroom.

The tool foreman has a wonderful opportunity to increase the efficiency of tool service by studying his men, taking a tactful interest in their personal problems, and in common with all other railway supervisory officers combating the campaign of criticism against the railroads and the tendency (probably less common now than it was three years ago) of doing as little work as possible for a day's pay. It may not always be easy for a foreman to meet the arguments of a glib-tongued fellow who spreads insidious propaganda with little regard for the truth. It is up to the foreman, however, to look up the facts and refute the man's arguments, otherwise he will lose standing with his own men and be negligent in duty to the railroad which employs him and on whose success and prosperity his own livelihood depends.

The tool foreman should help his men increase their knowledge of tools and tool making and in particular lend encouragement and assistance to any apprentice boys who may show special aptitude for tool room work. In connection with educational work the tool foreman should not neglect the opportunity to attend conventions like the present one of the American Railway Tool Foremen's Association. He should begin his campaign for permis-

*Address before American Railway Tool Foremen's Association at Chicago, September 4, 1925.

sion to attend these conventions early enough in the preceding year to insure success and wherever possible bring one or two or more of his leading workmen with him. They will all be benefited in direct proportion as they help in the preparation of papers, participate in discussion and above all take home and put into practice some of the ideas here developed. The advisability of reading all possible books and literature on tool making subjects need hardly be emphasized and the next best thing to attending the conventions is to read the record of the proceedings published in the *Railway Mechanical Engineer* and other technical papers which report the meetings.

Method of organizing the work

Space and time limitations prevent more than a mere outline in this paper of toolroom methods which have proved effective on various roads. As may be inferred from previous paragraphs, one of the greatest possibilities of economy on a railroad system as a whole is by the adoption of standard tools best suited to the needs of the individual roads. These tools should be limited to as few kinds and sizes as consistent, in order to minimize the number of repair parts which must be carried in stock and reduce the possibility of delay due to specific repair parts not being in stock. Standard instructions covering the kind of commercial tools to be ordered and the methods recommended for making those of special design in railroad toolrooms, have been compiled in the form of tool folios by several roads and promise to be real cost reducers through reduction of initial tool cost, cost of tool maintenance and by providing more efficient tools to the various shop departments.

Standardization is the keynote of economy in the toolroom. With system standardization, many of the special tools which railroads must make for themselves are used in such quantities as to justify the organization of a central manufacturing tool department, equipped with modern machines to turn out those tools at greatly reduced cost. The saving in cost of making the tools, however, is insignificant compared to the reduced cost of performing shop and enginehouse work with tools which are properly designed, made of the right kind of material and turned out with the proper inspection and supervision over each operation.

The question of how large a road must be to make a centralized manufacturing toolroom profitable is not easy to decide. Doubtless there should be many more toolrooms of this type than now exist.

What toolroom equipment is required

An able discussion of the types of machines needed in the large manufacturing toolroom, medium size maintenance toolroom and smaller toolrooms at outlying points has been presented at this convention by C. A. Shaffer, supervisor of shop machinery and tools of the Illinois Central. It may be well, however, to emphasize the importance of the screw machine or turret lathe for working up bar stock in the manufacturing toolroom, the punch press for stamping out gages in a fraction of the time required by hand, an automatic gear cutting machine where gears are cut in the toolroom, adequate milling machines of the plain and universal types and a full complement of grinding machines of ample size to handle the work and equipped where necessary with magnetic chucks.

The amount and kind of heat treating equipment will bear close investigation. An instance happened not many months ago in which a milling cutter worth upwards of $200 was absolutely ruined through the attempt to heat treat it in a furnace of insufficient capacity. It wouldn't take the loss of many such milling cutters to equal the price of a new furnace.

In conclusion, it may not be amiss to suggest that the tool supervisor or foreman, having perfected his organization, trained his men and standardized tool requirements, make an intensive study of his present toolroom machinery and equipment with a view to determining what could be accomplished with machines of more modern type. If savings can be effected show the "old man" the actual figures. If he has a grouch the first day you submit the figures, try him the next day from a new angle. He will think more of a man who, after forming his opinion, sticks to it. Whatever you do, never let him forget that the toolroom, as supervised by the efficient tool foreman, is the heart center of his entire shop and an important factor in railroad operation.

Portable cylinder saddle milling machine

By L. V. Mallory

Machine shop foreman, Missouri Pacific, Kansas City, Mo.

REALIZING the time and labor expended in most locomotive repair shops in fitting locomotive cylinder saddles to the boiler, the author has designed a simple, portable, milling machine which can be built at small cost, compared with the saving derived from its use in fitting saddles.

The vertical supports *A*, Fig. 2, which may be made either of 3¼-in. steel shafting or 2¼-in. by 3¼-in. steel tubing, are secured firmly at each end of the cylinder saddle by brackets *B*, Fig. 2, in such a manner that they can be adjusted by sliding them up or down to suit any required radius. The fulcrum shaft *C* is carried by the

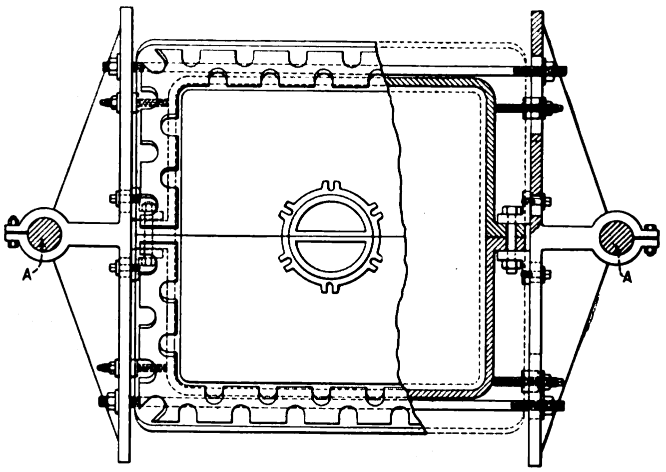


Fig. 1—Method of applying the fulcrum shaft support bracket to the cylinders

bearing located at the top of the vertical supports *A*. An ordinary cylinder boring bar can be used for this purpose without any alterations. The milling machine assembly is suspended from it.

The radius arm hanger, through which the fulcrum shaft passes, is made in two parts. The upper part *D* is secured to the fulcrum shaft *C* and contains a half-nut which engages with the fulcrum shaft lead screw. This nut can be disengaged at the will of the operator by means of a release spring and an eccentric mechanism. The fulcrum shaft lead screw is equipped on one end with a hand wheel *E*, which facilitates moving the miller head horizontally. The lower part of the radius arm hanger *F* is secured to the upper part *D* by bolts the heads of which slide in an annular tee slot which is concentric with the

central recess of the upper hanger *D*. This arrangement permits the miller cutter to traverse its work either radially or horizontally, which requires a difference in position of 90 deg. The lower part of radius hanger *F* contains two sockets which receive the radius arms *G* which are adjustable in the sockets and can be clamped rigidly at any desired point by means of cap screws. The lower part of *F* also contains a radius nut which engages the radius adjustment screw *H*. For convenience, this screw is operated by a hand wheel through bevel gears which are carried on a bracket.

The lower ends of the radius arms *G* are fixed in the miller frame which carries the worm gear and the miller cutter assembly, the feed screw yoke, the feed screw bevel gears, the feed screw counter shaft and the feed gears all of which are clearly shown in Fig. 4.

The worm shaft of the driving gear assembly terminates in a shank of suitable size and shape to fit the air motor socket which allows the motor to be mounted as shown at *I* Fig. 3. The driven worm gear is mounted within the housing which is on the cutter shaft. This shaft extends through the housing and through the miller frame bearings. It carries on one end the driving feed gear and

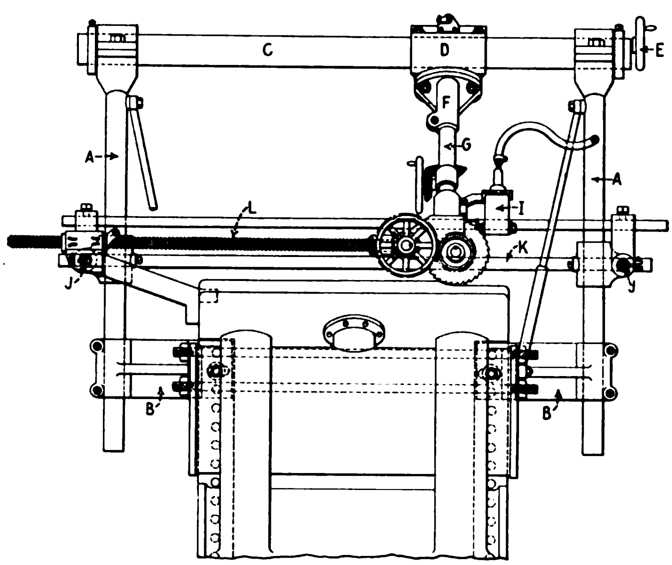


Fig. 2—Side view of the cylinder saddle milling machine

terminates on the other end in a tapered fit with a collar and nut for the purpose of securing the milling cutter when it is desired to mill in close places.

The main milling cutter is mounted on a shaft between the worm gear housing and the miller frame. When it is necessary to have the auxiliary cutter on the end of the shaft one should be used that is slightly larger than the main cutter between the frames. This will eliminate the removal of the regular cutter as it provides ample clearance for idling. The feed counter shaft carries on its outer end the feed gear which passes through the bearings in the frame as well as through the bearings in the yoke. The bevel gears are carried in this yoke with the driving gear mounted on the counter shaft and the driven gear on the feed screw.

The adjustable brackets are secured on each vertical support *A*, which, in turn, secure the transverse anchor rods *J*, Fig. 3. These rods terminate in eyes, through which passes the longitudinal anchor rod *K*, Fig. 2. The removable feed screw nut-assembly is hinged to the anchor rod *K*. The feed screw split nut assembly consists of two saddle nuts that engage the feed screw *L*, Fig. 2. These nuts are contained in a cage in such a manner that they can be engaged or disengaged from the feed screw at the will of the operator, by means of the operating rod *M*, Fig. 2, and engaging the split nut operating slides. The lower part of the split nut housing forms a hook which hinges on the anchor rod *K* which is closed by filler blocks in such a manner that the whole assembly is free to swing on the anchor rod.

From the manner in which the feed screw split nut

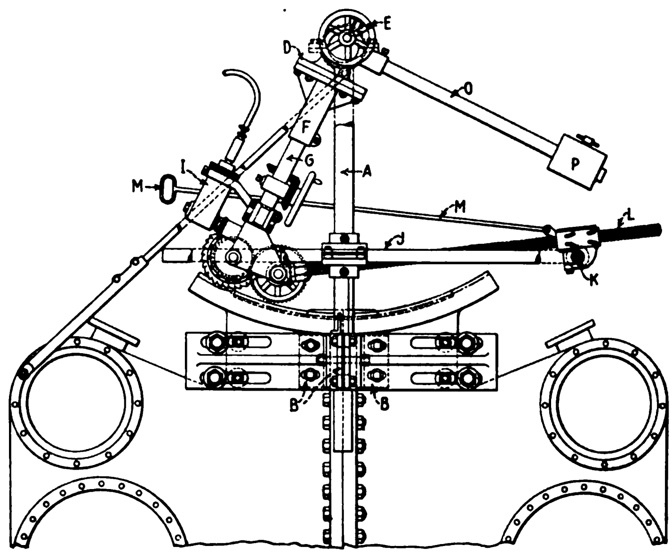


Fig. 3—Front view showing the method of mounting the cylinder saddle miller

hinges on the anchor rod *K* and the feed screw yoke hinges on the shaft connecting it with the miller frame, it is obvious that the miller head will be drawn toward the anchor rod *K* and that the feed screw *L* will always be in perfect alinement at all positions of the miller-head.

When milling the side flanges, the feed screw split nut

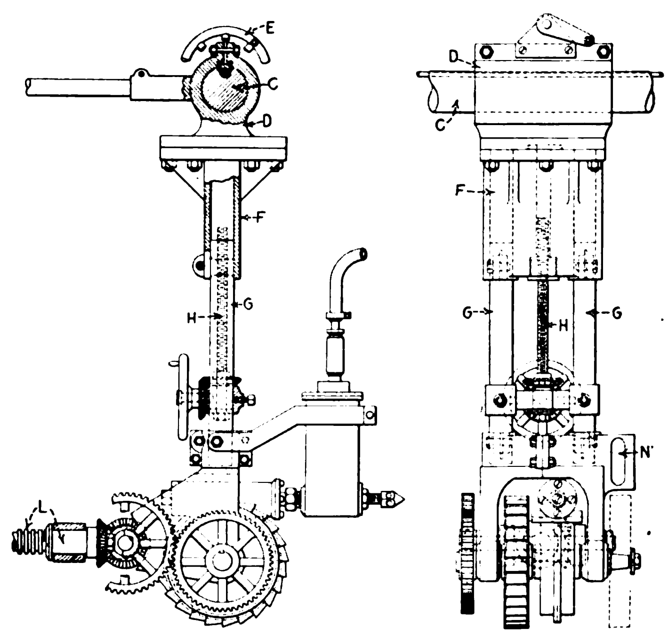


Fig. 4—Miller head and radius arm for the cylinder saddle radial miller

is removed from the rod *K* and placed on the transverse anchor rod *J*. The Miller-head is turned 90 deg. from its former position. A guide rod is then passed through the slot *N*, Fig. 4, which is secured at each end to the anchor rods *J* by suitable brackets. It can be slid along the rods *J* and fastened at any desired point but they must be set

at a different point each time a longitudinal cut is taken in order to move the cutter over in position for a new cut. When making these longitudinal cuts, the saddle nut is disengaged from the lead screw, allowing the radius arm hanger to slide along the fulcrum shaft *C* as the cutter advances. A spacer bracket attached to the rod *J* and heels against the cylinder saddle serves to stiffen the anchor rod *J* when making the longitudinal cuts. The upper part of the radius arm hanger *D* has a socket in which the counter weight lever *O*, Fig. 3, is fixed, which carries the counter weight *P*. The vertical supports *A* are diagonally braced by adjustable braces whose lower ends connect with the valve chamber or cylinder head studs. Referring to Fig. 1, the fulcrum, shaft support brackets have two horizontal slots in each end through which pass the tie rods or studs. Spacer screws also are set in these slots. These slots make it possible to fit the brackets to different widths and styles of cylinder saddles, allowing the tie rods to lie up close to the neck of the cylinder saddle, thus insuring a more rigid anchorage of the brackets. The spacer screws serve to stiffen the support brackets at the points where the tie rods exert their pressure. They also engage with specially designed nuts that have projecting lugs which fit in the tie rod slots. These nuts have shoulders or flanges that lap over the edges of the slots on the inner face of the support brackets. The spacer screws are of sufficient length to pass through the nuts and to the end surfaces of the neck of the saddle.

Near the center of the support brackets are four smaller slots through which pass the cap screws which screw in the angle brackets located on the inner surface of the support brackets in such a manner that the splice flanges of the cylinder saddles come vertically between them. The part of the angle brackets that meet the splice ranges are slotted so that an alinement can be made with one of the bolt holes already in the splice flanges. A clamp bolt nut is put through the angle brackets and splice-flanges when the clamp bolt is tightened. The support brackets *B* are adjusted laterally in such a manner that the center of the receiving sockets for the vertical supports *A* line up vertically with the center of the cylinder saddle. When this adjustment is made the cap screws are tightened, thus insuring a rigid central support that holds the fulcrum shaft accurately in position. The spacer screws are then adjusted until they press firmly against the neck of the cylinder saddle after which the tie rods may be drawn tight. There are milling cutters on the market having inserted teeth that can be used to advantage in this machine. The machine can be driven by either an air or an electric motor.

Pointers on forging machine dies*

Die design and construction not a one-man job—Co-operation between forge shop and tool room desirable

THE success of forging machine dies in railroad shops depends on their correct design, the use of proper materials in their construction and accurate die alinement in the forging machines. Experience has shown that where greater heat resisting properties than possessed by carbon steel are required, chrome, or tungsten alloy steel should be used, the application being in the form of inserts wherever possible in order to reduce the first cost.

The principal causes of die deterioration are generally recognized as abrasion, heat and pressure. Excessive pressure is the least of forging die problems as the gripping dies and heading tools are generally heavy enough to withstand the forging pressure. Abrasion, that ever present factor which causes ultimate deterioration of dies but not necessarily their early failure, cannot wholly be prevented. The skill of the designer plays an important part in designing dies in which excessive abrasion takes the longest time to develop. The constant jets of water which should play on the dies while in operation are depended upon to minimize abrasion by working the scale out of the impressions as well as keeping the dies cool.

Observation has shown that heat is the greatest enemy of satisfactory die life. This fact may be readily observed where the die impression or header is surrounded with hot stock in its operation, such as is the case with bushing dies, pin slot punches, or castellated nut dies. Dies subject to a great amount of heat, or used for the production of a large amount of forgings in rapid succession, held to certain close limits, should be made of alloy or other steel with high heat resisting qualities. Dies constructed of steel for this class of work give more service, better forgings and are less expensive to maintain.

An example of a case of this kind may be mentioned as follows: A set of bushing dies was sunk in cast iron blocks with die block steel headers and punches, 500 to 600 bushings being about the limit of production of these dies without re-working. The cast iron dies were replaced with steel dies (45 to 50 point carbon) and the production increased to 1,500 bushings before repairs were needed. Even then it was simply necessary to straighten up the edges where they had turned in from heat and pressure.

It must be understood that cast iron dies should not be entirely dispensed with, for in certain forging operations such as welding, cast iron gives better results than steel. Again, where a number of forgings are needed which will never be duplicated, cast iron is the logical material to use as it represents a much smaller investment than steel and does the work just as well. Die service depends to a certain extent upon the skill of the operator in making sure that the material worked with is properly heated and gaged so that when the dies close it will be upon the proper amount of material to make the forging. All this means longer life of the dies and less up-keep expense on the machines.

Co-operation between the forge shop and the toolroom go a long way toward reducing the cost of maintenance, and the construction of new dies. It is no one-man's job. Exchanging ideas brings the best results.

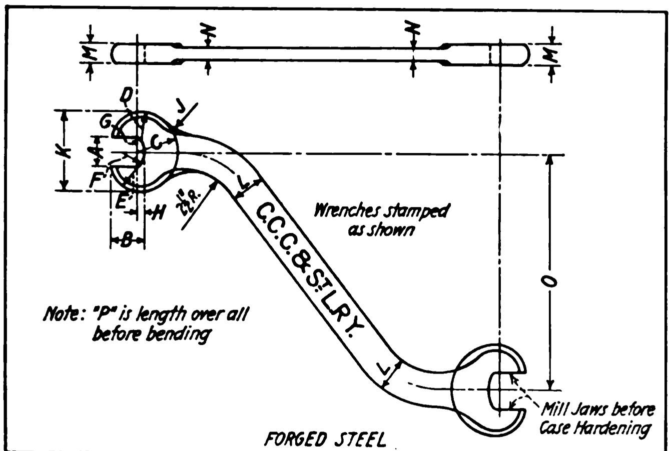
In preparing a paper on this subject your committee

*Abstract of a regular report of the Committee on Forging Machine Dies presented at the thirteenth annual convention of the American Railway Tool Foremen's Association held in Chicago September 2, 3 and 5, as reported on page 639 of the October *Railway Mechanical Engineer*. The report was read by Chairman E. A. Hildebrandt, tool foreman of the Cleveland, Cincinnati, Chicago & St. Louis at Beech Grove shops, Ind., who is the new president-elect of the association. Other members of the forging machine die committee included C. B. Heingarten, Chicago & North Western, Chicago; C. C. Burke, Chesapeake & Ohio, Peru, Ind.; A. C. Roepke, Union Pacific, Los Angeles, Cal., and C. Petran, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.

is aware of the fact that there is perhaps little information we could offer that is entirely new, but we are pleased to be able to furnish information regarding dies which we feel have been a real factor in reducing the cost of shopping locomotives and cars.

Following are several drawings and explanations of practices on the Cleveland, Cincinnati, Chicago & St. Louis at Beech Grove shops, Ind.

S-Wrenches—These are made on a 4-in. forging machine and a Bradley hammer. The dies are made of die block steel (55 to 60 point carbon). The Bradley hammer dies are hardened and tempered, the forming and punching die and headers not being hardened. The first operation in forging S-wrenches is cutting to proper length a piece of machine steel 1/4 in. smaller

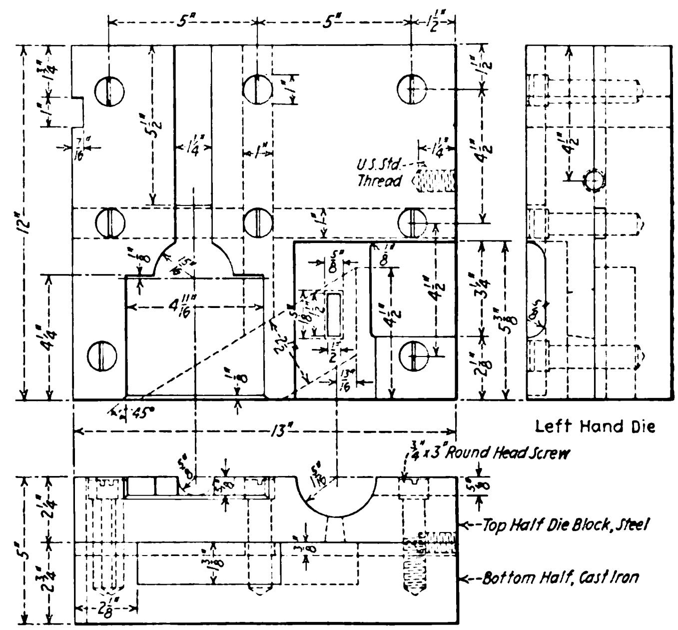


P	O	N	M	L	K	J	H	G	F	E	D	C	B	A	Size	Wrench No.	Line No.
10 1/2"	4 1/2"	5/16"	5/16"	5/8"	1 3/8"	5/8"	5/16"	1/8"	5/8"	1/2"	–	9/16"	41/64"	17/32"	1/4"	7	1
				5/8"	1 3/8"	5/8"	5/16"	1/8"	3/4"	5/8"	–	11/16"	55/64"	23/32"	3/8"		2
15"	7"	3/8"	9/16"	1"	2 3/8"	11/16"	1/4"	17/64"	35/64"	7/8"	1"	1 15/64"	1 1/64"	29/32"	1/2"	1	3
			5/8"	1"	2 3/4"	13/16"	9/32"	5/32"	27/32"	1 3/32"	1 15/32"	1 21/64"	1 7/64"	1 3/32"	5/8"		4
17 1/2"	7"	7/16"	11/16"	1 1/8"	2 31/32"	13/16"	21/64"	19/64"	15/16"	1 3/64"	1 1/4"	1 19/32"	1 13/64"	1 9/32"	3/4"	2	5
			3/4"	1 1/8"	3 1/2"	13/16"	25/64"	1/8"	1 1/16"	1 9/32"	1 1/2"	1 45/64"	1 1/2"	1 15/32"	7/8"		6
20 1/2"	7"	1/2"	13/16"	1 1/4"	3 5/8"	13/16"	27/64"	19/64"	1 13/32"	1 15/32"	1 3/8"	1 53/64"	1 19/32"	1 11/16"	1"	3	7
			7/8"	1 1/4"	4"	13/16"	31/64"	5/16"	1 13/32"	1 1/2"	1 11/32"	1 15/16"	1 23/32"	1 7/8"	1 1/8"		8
24"	7"	23/32"	1"	1 1/2"	4 13/32"	13/16"	33/64"	5/16"	1 3/4"	1 3/4"	–	2 7/32"	2 1/64"	2 1/16"	1 1/4"	4	9
				1 1/2"	5 3/16"	13/16"	37/64"	5/16"	2 1/16"	1 19/32"	–	2 19/32"	2 11/64"	2 7/16"	1 1/2"		10
28"	10"	15/16"	1 1/4"	2"	5 9/16"	1"	39/64"	5/16"	2 7/32"	1 27/32"	–	2 25/32"	2 27/64"	2 5/8"	1 5/8"	8	11
				2"	6"	1"	21/32"	5/16"	2 3/8"	2 7/32"	–	3"	2 49/64"	2 13/16"	1 3/4"		12
10 1/2"	2 3/4"	3/8"	3/8"	3/4"	2 3/4"	5/8"	1/4"	1/8"	5/8"	1 1/16"	–	1 3/16"	1 9/32"	25/32"	1/2" Cap Screw	6	13
				3/4"	2 3/4"	5/8"	1/4"	1/8"	5/8"	1 1/16"	–	1 3/16"	1 1/64"	29/32"	1/2" Std. Nut		14
10 1/2"	2 3/4"	3/8"	9/16"	1"	2 3/8"	5/8"	1/4"	17/64"	35/64"	7/8"	–	1 15/64"	1 1/64"	29/32"	1/2"	5	15
				1"	2 3/4"	13/16"	9/32"	5/32"	27/32"	1 3/32"	1 15/32"	1 21/64"	1 7/64"	1 3/32"	5/8"		16

S-wrench made on Bradley hammer and 4-in. forging machine

than two times the dimension *D* in the wrench drawing. Next a ball is formed on each end and the handle of the wrench is drawn out; the ball on each end is flattened to approximately the finished side of the outside diameter of the jaws of the wrench, these operations all being done on Bradley hammer balling dies. The next operation is done in the forging dies with the first operation header, which punches and forms the jaw; the wrench is then passed to the next impression and the header, which is 1/16 in. larger than the punching header, forms the outside dimensions, leaving enough stock in the jaw for machining the wrench to standard size. The fourth operation consists of bending the wrench to the proper shape on a small bending machine which is near the forging machine. The second, third and fourth operations are all made with one heat.

All wrenches are forged smaller in the jaws than the nut size and are milled to size with a pair of straddle cutters. The wrenches are held in an air clamp while

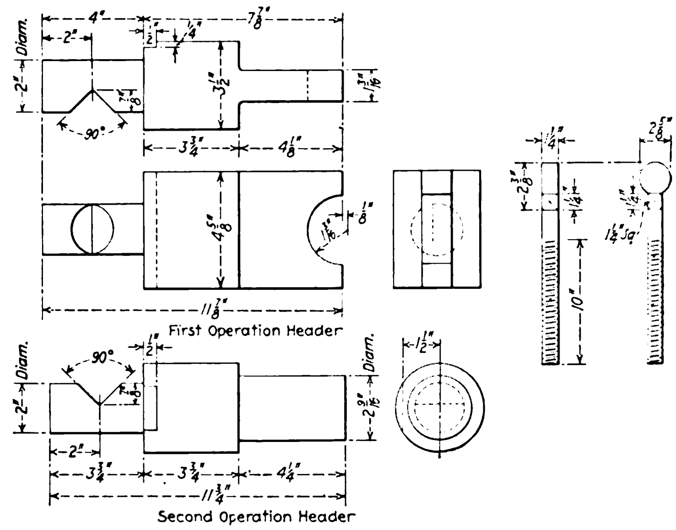


Forging die for 1 1/4-in. wedge bolt

milling, the burrs being ground off and the wrenches then case hardened.

The production of 1 3/4-in. wrenches on the Bradley hammer is three an hour; the production on the forging machine is ten an hour, this production increasing on the smaller size wrenches.

Wedge bolts—The dies for wedge bolts, made of die block

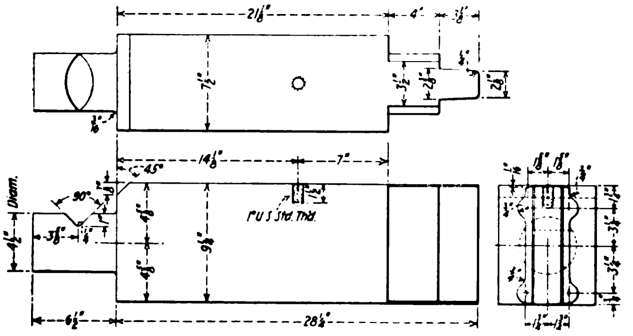


Header dies for 1 1/4-in. wedge bolt—Dimensions of bolt

steel backed with cast iron, are used on a 2 1/2-in. forging machine. The diameter of the wedge bolt head for the 1 1/4-in. bolt is 2 5/8 in., the thickness being 1 1/4 in. and it takes approximately 5 in. of stock to make this bolt. The work is done in one operation by allowing the header to enter the die before it strikes the material. The header upon entering the die begins to form a pocket in which the stock is carried forward until it forms the head of the bolt. The surplus stock or flash flows into the 1/4 in.

clearance space between the header and the dies when the header is at the end of its stroke. This flash is trimmd off in the next pass of the dies and the slugs drop out at the back of the die through the 1⅜-in. by 2½-in. slot shown on the forging die drawing.

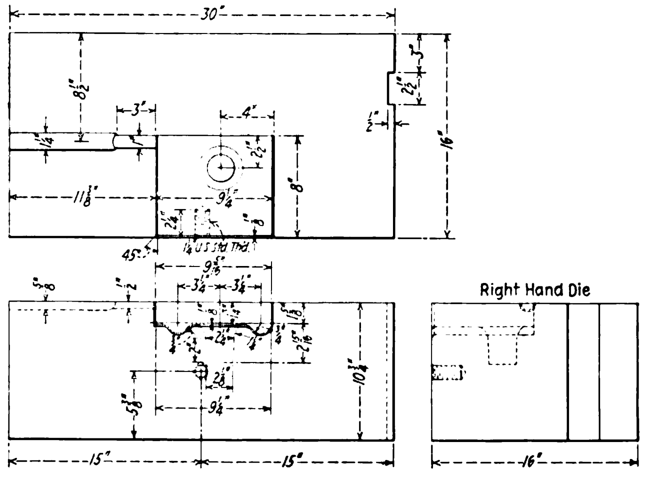
The bolts are taken to the punch press and in two operations the head is sheared to a limit of .002 in. in diameter by being punched through a shearing die. The bolts are then threaded, sent to the storehouse and ordered out as needed. A tolerance of .007 in. between the size of the bolt head and the hole in the wedge is maintained. There is no unnecessary filing or grinding to do; the wedges and the bolts are ready for application when ordered from stock.



Header die for radius bar lifter

The idea of making the die in two parts was mainly to simplify machining operations. Thirty wedge bolts is the average production for an hour on the forging machine; bolts are trimmed to size at the rate of 50 an hour.

When a header of this kind breaks, the broken end is cut off and a slot is cut in the body of the header which then answers the purpose of an adapter for a new header blade. The blades are held in place by bolts of suitable size, which the snugly fitted in both the blade and adapter.



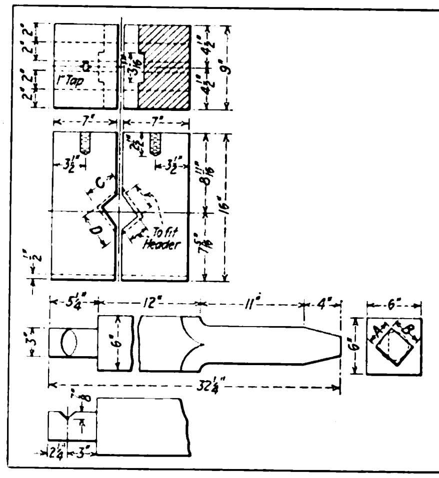
Forging die for radius bar lifter

This method of repairing saves considerale time and material as the blades for various kinds of headers are kept in stock and when one breaks all that is necessary is to change blades. Otherwise, it would mean a complete new header. Die block steel costs money as well as time to machine it. Here is a chance to save several dollars on each header if you are not already repairing them this way.

Radius bar lifter boxes—These boxes are forged in one operation. The dies are sunk in 11-in. by 16-in. by 30-in. cast iron blocks with a die block steel header and are used on a 7-in. forging machine.

As it would be difficult to make steel flow in one operation to make a forging of this kind, iron is used which is cut into 2⅝-in. by 5-in. by 8-in. blocks which are heated up to a white heat and a porter bar welded on. They are then passed into the dies from the top of the machine. It is more of a squeezing than an upsetting operation and it is very essential that the metal be thoroughly heated so that the bearing ends of the box will fill out with the least resistance and minimum strain on the dies and machine. An everage of four boxes an hour can be produced with these dies. The trimming is all done by the machine operator.

Small spring bands.—The first operation in forging small spring bands is to cut material of the proper thickness and width and bend it on an air machine to form a rectangle approximately the size of the band, allowing enough stock in length to make a scarf weld. The second operation is performed in the dies, the partly finished band being heated to a welding heat at the scarf and placed in the pocket of the dies; the header passes through the band and forms and welds it, the surplus stock, if any, flashing out either at the front or back end of the die. This flash is trimmed off by the machine operator and the band is ready for application to the spring leaves.



USED ON	D	C	B	A	DIE No.	LINE No.
4" Mach.	4 7/8"	2 1/2"	4 1/8"	1 3/4"	159	1
"	3 7/8"	2 3/4"	3 1/8"	2"	160	2
"	3 7/8"	3 1/8"	3 1/8"	2 7/8"	161	3
"	3 7/8"	3 1/2"	3 1/8"	2 3/4"	162	4
"	3 7/8"	3 7/8"	3 1/8"	3 1/8"	163	5
"	4 1/4"	3 7/8"	3 1/2"	3 1/8"	164	6
"	4 3/8"	2 3/4"	3 5/8"	2"	165	7
"	4 3/8"	3 1/8"	3 5/8"	2 7/8"	166	8
"	4 3/8"	3 1/2"	3 5/8"	2 3/4"	167	9
"	5 5/8"	4 3/8"	3 7/8"	3 5/8"	168	10
"	4 7/8"	3 1/2"	4 1/8"	2 3/4"	169	11
"	4 7/8"	4"	4 1/8"	3 1/4"	170	12
"	4 7/8"	4 3/8"	4 1/8"	3 7/8"	171	13
"	4 7/8"	4 7/8"	4 1/8"	4 1/8"	172	14
"	5 3/8"	3 1/8"	4 5/8"	2 3/8"	173	15
"	5 3/8"	3 1/2"	4 5/8"	2 3/4"	174	16
"	4 7/8"	3 1/8"	4 1/8"	2 7/8"	186	17

Small spring band dies and header

Large spring bands—The first operation in forging large bands is to shape and bend the stock on the bulldozer as shown in the insert sketch. Enough stock is allowed when cutting to length to assure proper thickness of the spring band on the heavy end. In this set of dies it will be noticed that the header does not pass through the spring band, but that the inside dimensions of the band are formed by the bosses on each half of the dies. The header strikes the long end of the partly shaped band, and welds and forges it to thickness in one operation. The ⅞-in. groove cut in the dies is an outlet for surplus stock.

It is not necessary to heat the band all over, but to a good welding heat on the ends that are to be upset and welded. A back stop must be used to hold the band in the dies. These dies, used in a 4-in. machine, are sunk in cast iron which we find is much better than steel for this kind of work. Steel checks much quicker than cast iron and forgings are more apt to stick in the dies. The headers are made of die block steel. An average production of 10 bands an hour is secured with these dies.

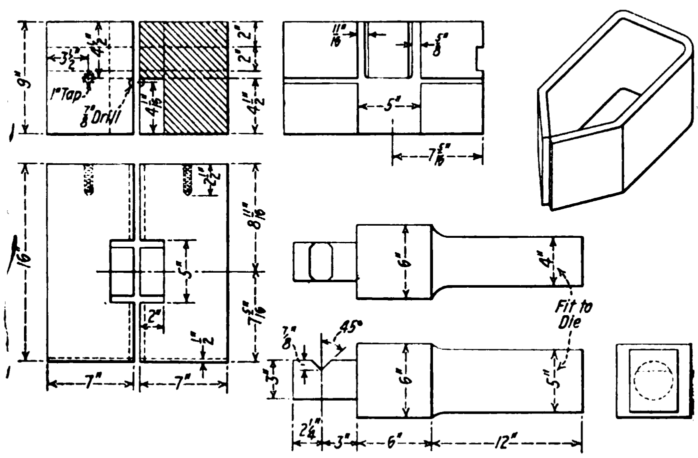
Brake beam safety straps—These straps are made of 2-in. by 2-in. by ⅜-in. angle iron in one operation on the

bulldozer. The header is mounted on a wrought iron plate bolted to the head of the machine. This header has a die block steel insert which contains the three 13/16-in. punches and is removable. Should it be necessary to change punches, the insert is removed by taking out two fillister head set screws; standard boiler punches (made of 90 point carbon steel) which are kept in stock are applied. The change can be made with very little delay to production, as it is not necessary to remove the header from the machine.

The die portion of the former is made of machine steel and is mounted on a cast-iron sub-plate bolted to the bed of the machine. The punching die is made of tool steel and is held in position by two dowel pins and two screws.

The old way of making the straps required the bending, laying out and drilling operations as well as extra trucking. The laying out, drilling and a part of the trucking expense has been eliminated as the work is all done (with the exception of shearing to length) in one machine. The straps are heated in an oil-burning furnace and a production of 40 finished straps an hour is realized.

Brake staffs—A set of sliding block dies is used in a 7-in. machine for upsetting the square part of a brake staff. The bodies of the dies are made of cast iron and



Large spring band dies and header—Insert shows band after first operation of bending on bulldozer

the sliding block and header are of die block steel. The cast iron section of the die holds the work and is milled with a 1/32-in grip.

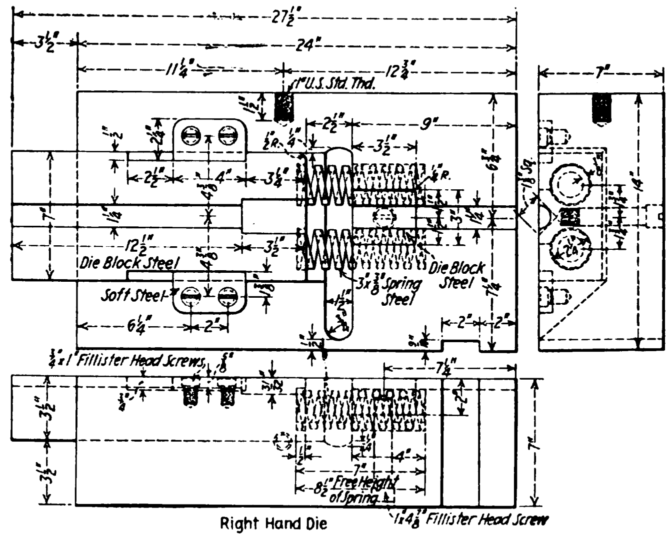
The sliding block is bored to the size of the stock and contains the impression of the square. As the square part on the brake staff is 2 ft. 10⅛ in. from the end it is necessary to drill a hole ⅛ in. larger than the size of the stock through the header through which the stock is passed. It is essential that the bars for the brake staff all be the same length to avoid buckling in the header and crosshead on account of too much stock.

A 1½-in. steel bar is placed in the hole in the crosshead, cut to the proper length so that when the crosshead comes forward the bar strikes the end of the brake staff at the same time the header strikes the sliding block which carries the stock forward and forms the square. The brake staffs are all gaged from the back stop on the machine.

The scale from the work drops out through the 1½-in. channel shown on the drawing. On the return stroke of the machine the springs push the sliding block back to its starting position.

Fourteen brake staffs an hour can be squared with these dies. It is very important that the heats be gaged the proper distance from the end of the bars, to avoid the possibility of damage to the dies if allowed to close on improperly heated stock. The length of the heats must be gaged in proportion to the amount of material to be upset. Too long a heat will cause the stock to buckle.

A die house is provided at Beech Grove where all dies and templates used in the forge shop are kept. There are over 850 sets of dies and special punch press tools which are looked after by one man, who keeps the dies and headers in relative order, cleans them and wipes them with oily waste to prevent rusting, checks them in and

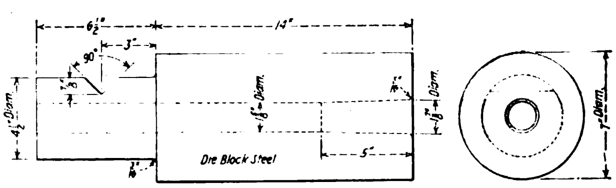


Sliding block forging dies for 1¼-in. brake staff

out and sends them to the toolroom whenever repairs are needed.

The dies are all numbered, blocks with two sets of dies in them having two numbers. The machine operator is furnished with a set of checks which are used only for checking out sets of dies as needed. The check is hung on a board together with the number of the die. When the job is completed the dies are returned, inspected, and if in need of repairs are sent to the toolroom. This system eliminates the practice, sometimes followed where there are duplicate sets of dies, of obtaining another set of dies without reporting that the set which was in use failed or needed repairs. It also assures one good set of dies while another is being repaired.

Before the die house was built, dies were left around



Header die for 1¼-in. and 1⅜-in. brake staff

the machines in the shops, taking up valuable space, and it often happened that they were covered up with heavy material. Sometimes they were set outside and exposed to the elements and in winter they had to be dug out of the snow. All this caused unnecessary die deterioration. Cast iron or steel such as is used for dies will oxidize to a depth of .010 in. to .015 in. over a period of 90 days when kept exposed to the elements. This means that a die which had .020 in. grip has rusted to the extent that it has no grip at all. The remedy is to take it to the toolroom, grind or plane some off so the dies will hold—all an unnecessary waste of time and material. Dies are invested capital and must be taken care of in order to

give the best results and yield the greatest returns from the investment with the least possible amount of maintenance cost.

Maintaining the precision reverse gear

By A. T. E.

In order properly to maintain the Franklin Precision reverse gear, it is necessary to grind the seats of the slide valve occasionally and to renew the cylinder packing leathers. It is impossible to remove the valve operating arm without taking out the back cylinder head. The two cast iron face plates shown in the sketch were made for the purpose of regrinding the joint between the slide valve and its seat. The work of grinding in a slide valve has often been a bigger job than the enginehouse foreman likes to admit, especially when locomotives are being

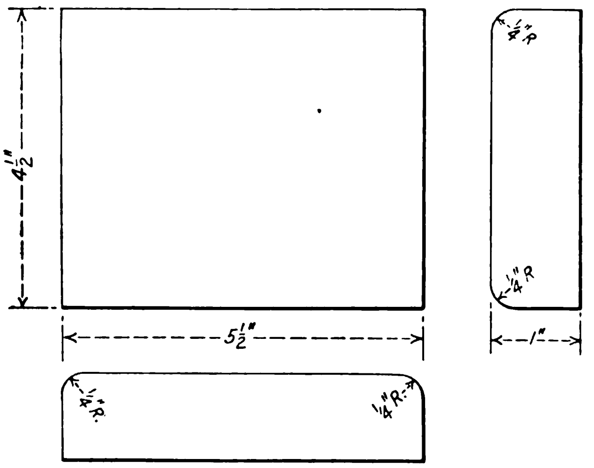


FIG. 1

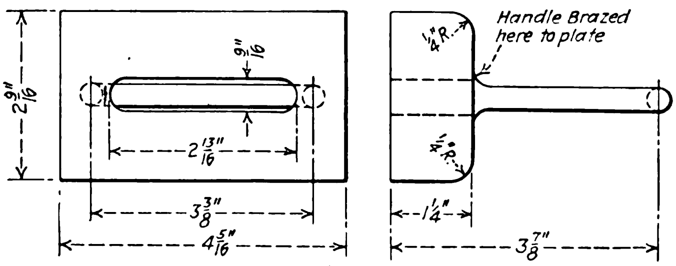


FIG. 2

The face plate shown in Fig. 1 is used to grind the slide valve—Fig. 2 is for the valve seats

turned on short time. However, by the use of these face plates, a mechanic has only to remove the slide valve chest cover and the slide valve in order to grind the seat with the face plate shown in Fig. 2 of the sketch. The valve is ground with the face plate shown in Fig. 1 and the reverse gear is then assembled for service.

In order to keep the face plates true, they should be machined occasionally and frequently lapped and ground together. By using these plates reverse gears can be kept in good condition with little loss of time and there will be few occasions where a locomotive will be held for repairs to the reverse gear only.

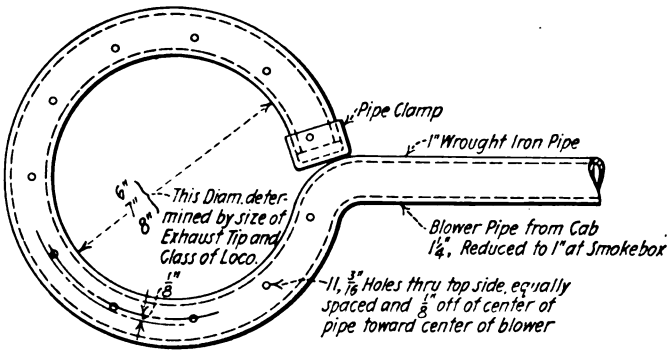
In order to renew the reverse cylinder cup leathers, it is necessary to remove both the front and back cylinder heads. There being no counterbores in either end of the cylinder it is a difficult job to slip a piston through with new cup leathers. However, by assembling the piston at the bench, the back cup leathers can be guided into place by the use of thin tin strips. One objection to this method is that it is usually quite difficult to get the back leather into the cylinder and the triple screw into the piston trunk at the same time.

A better way of doing this job is to slip the back cup leather and the piston follower from the front into the back end of the cylinder at the beginning, and then place the indicator block in the cab in the extreme forward position. As the mechanic starts the screw into the piston trunk, he pulls the balance of the piston parts as far into the cylinder as possible by rotating the hand wheel in the cab as if reversing the engine. Usually the follower stud holes in the piston head will not line up with the follower studs when reassembling the piston. When this occurs, run the piston ahead a few revolutions of the hand wheel and clamp a wrench on the flat end of the piston trunk, turning it a little to the left, and at the same time hold the screw from turning. Then run the piston to the back of the cylinder until the studs are inserted in the follower stud holes in the piston head. Screw a couple of nuts on the studs by hand and move the piston to the front cylinder where all the nuts on the studs can be tightened more conveniently.

Locomotive blower pipe

The Minneapolis & St. Louis has experimented recently with a blower of the design indicated in the drawing which apparently has important advantages over some of the other types commonly used.

This blower is circular in shape and made from common wrought iron pipe in the shop. The blower lies flat on the table plate, fitting snugly around the outside of the nozzle tip. The end of the blower is closed with a pipe cap and is attached to the blower line in the usual manner. Holes 3/16 in. in diameter, equally spaced and usually about 1½ in. apart are bored in the top of the blower

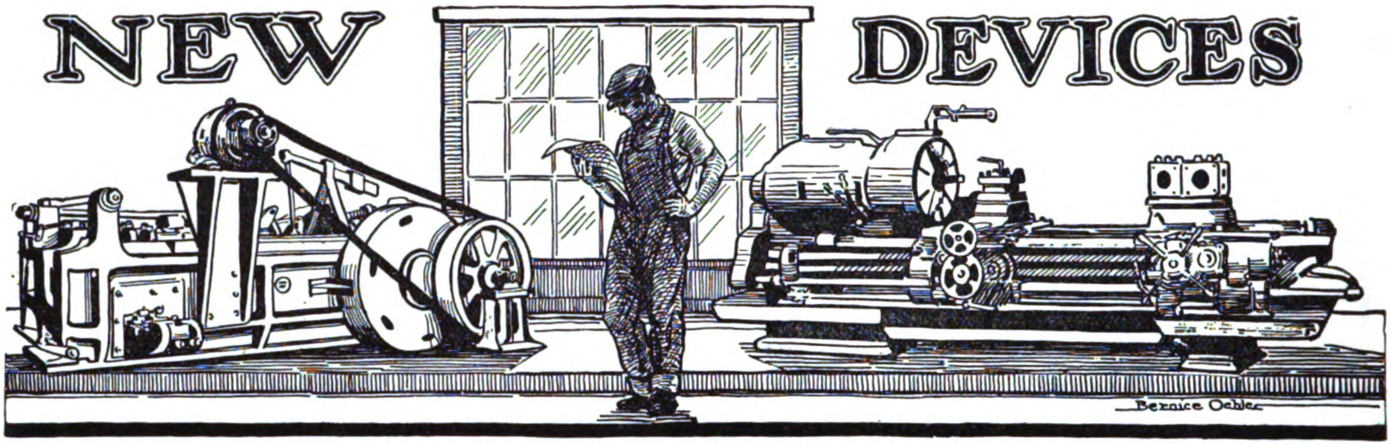


Locomotive blower which has given good results on the Minneapolis & St. Paul

⅛ in. off center and pitched so that the several jets of steam converge at the choke of the stack.

The diameter and size of the blower and number of holes is determined by the size of the nozzle opening. On engines having a 4-in. tip, ¾-in. pipe is used and on engines having a 6-in. nozzle tip, 1-in. pipe is used.

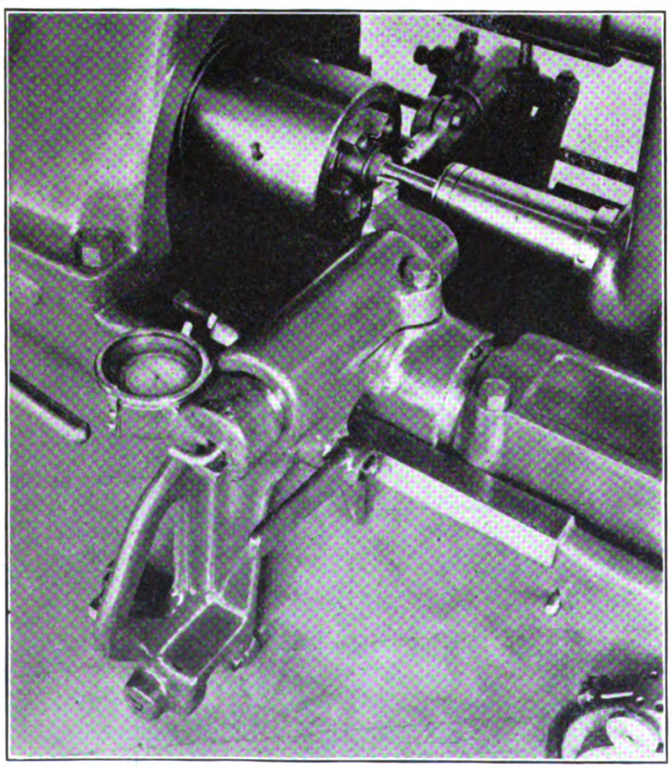
Actual tests have shown that this type of blower uses only one-fourth the usual amount of steam required for blowing up a boiler. It is far more efficient and in addition is practically noiseless, a desirable feature particularly around passenger stations and in enginehouses. Some of these blowers have been in service for more than a year, and require practically no maintenance.



Improvements in Bryant internal grinders

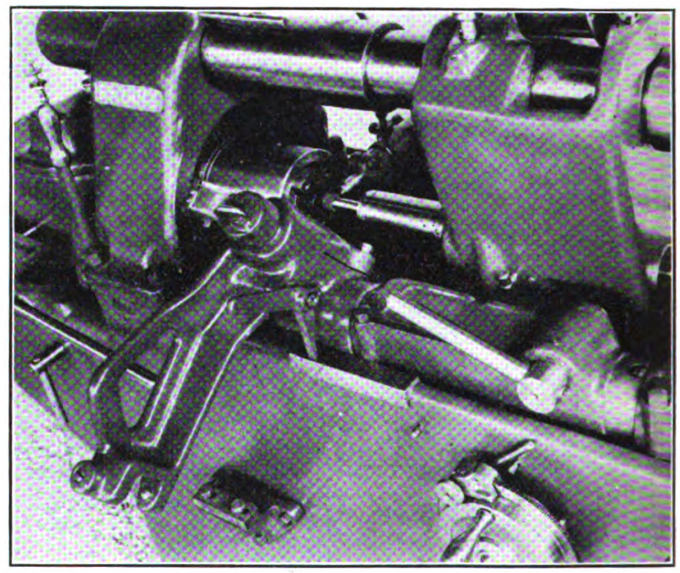
FOUR major improvements have been made by the Bryant Chucking Grinder Company, Springfield, Vt., which can be applied to any standard Bryant hole grinder. All of these improvements are found on the No. 6 semi-automatic hole grinder which is particularly adaptable to railway shops.

The first of these improvements is an automatic size indicating attachment, the use of which enables the operator to know when the desired diameter of a hole has been reached without the necessity of constant measuring with a plug gage. When in position, it does not interfere with the movements of the operator. It consists



Automatic size indicating attachment applied to a No. 6 Bryant internal grinder

primarily of a diamond gaging point in contact with the bore of the hole being ground, a dial indicator and means for communicating the movement of the gaging point to the dial of the indicator. All working parts, including the indicator, are enclosed to protect them from water and grit. A glass cover is fitted over the dial. The gaging point is a diamond carried by a small arm that projects into the hole. The diamond is smoothly finished on the contact surface to the radius of the smallest hole to be ground. The whole device is movable endwise by means



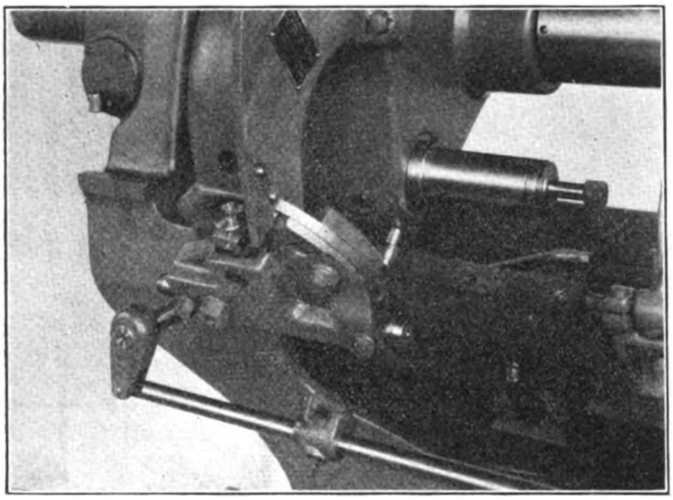
Adjustable wheel truing device in position

of a lever so that the gaging point may be instantly withdrawn from the hole and swung out of the way when changing the work.

It is a simple matter to set up the indicator. The first piece ground is finished to the desired size, being checked with a master gage. The gaging point is then brought in contact with this finished surface of the hole and the dial indicator is set at zero. All subsequent holes ground will be to the correct size when the dial indicator registers zero. After the grinding wheel has been started in a piece of work, the gaging point is brought into the hole, the diamond resting against the wall of the hole opposite the grinding wheel. The dial, previously set to the size of the hole required, immediately registers the amount that the hole is smaller than the normal size. This dial is graduated to indicate tenths of thousandths of an inch.

In order to prevent the wear of the diamond gaging point, especially when grinding holes with a rough surface, means are provided for relieving the diamond a few

thousandths from contact with the surface. When the rough surface or scale in the hole has been ground out, the diamond is brought back into contact with the surface of the hole. If desired, the diamond may remain in contact with the wall of the hold throughout the grinding. As the diameter of the hole approaches the normal size, the point of the indicator moves toward zero. When the pointer is at the zero mark, the operator knows that the hole is finished to the required size. He then withdraws



Control bar adjustment for grinding tapers

the grinding wheel and takes out the work. No plug gaging is necessary.

The success which has been obtained with this attachment is attributed chiefly to the control, which is on the same general principle as used for the Bryant wheel slide. The indicator head is attached to a heavy bar with bearings far enough apart to give control. The bearings are wholly enclosed and protected against grit. The bar moves longitudinally and swings in the same bearings, thus eliminating the need of gibbed cross slides. For holding the contact point in position, an arm is provided which is located by the control plate. This arm also serves as a handle for operating. At the same time, maintenance of accuracy has been made possible without sacrificing ease of operation.

An adjustable wheel truing device, shown in one of the illustrations, has been developed for use in connection with the Bryant sizing indicator. A micrometer adjustment is provided for moving the diamond in or out. With this arrangement it is an easy matter to set the diamond exactly in line with the diameter of the finished hole. If desired, the diamond can be set so that the wheel is dressed every time it is withdrawn from the finished hole, the diamond being set so that only a fraction of a thousandth of an inch of the wheel is removed, just enough to clean the surface and straighten the wheel. One pass of the wheel in front of the diamond as it is withdrawn from the hole is all that is necessary and this is automatically taken care of without any extra motion.

The chief advantage of this method is that the wheel is always straight and in perfect cutting condition, thus insuring better work both with regard to size and finish. It has also been found in many tests that the loss of wheel from dressing is less with this method than when the wheel is trued only when the operator happens to think of it. This diamond holder is operated by a lever conveniently placed so that it can be swung up out of the way when chucking or removing the work.

To facilitate the setting up of the machine for grinding taper holes, a micrometer adjustment, shown in one of the illustrations, has been provided for the control bar on the wheel slide. The swinging plate is accurately graduated up to a 45-deg. included angle. By the use of a special plate, an included angle of 60 deg. can be ground.

The flat control plate has been replaced with a round bar held in a swivel plate. This control bar is located in alinement with the slide bar when grinding straight holes. It engages a roll in the cross feed screw which minimizes wear. If wear does occur after considerable use the control bar can be turned in its seat slightly without losing its alinement. The control bar is clamped by two screws. The swivel plate, which carries the bar, is also clamped in place by two screws.

A hand lever has replaced the hand wheel as standard equipment for operating the chuck on Bryant grinders. The chuck operating lever is conveniently placed and helps increase the production with less exertion.

Solutions to prevent corrosion

ACIDS, alkalies, and moisture are the three main factors which cause the corrosion of steel railway rolling stock. Tests have proved that it is important that a protective coating should penetrate the exposed pores of the metal or surface to be protected. It should adhere firmly and fill every hole and crevice to seal the surface against the destructive action of water, acids or alkali.

The Quigley Furnace Specialties Company, Inc., 26 Cortland street, New York, have placed on the market a corrosive preventative solution, known as Triple A. These solutions are compounded from coal tar derivatives, carefully heat treated and are claimed not to crack, chip or peel. They contain no vegetable or animal oils, grease or turpentine and are said to form a lasting union with the surface covered which does not allow moisture or gases to creep through to the metal. This prevents oxidation and the pitting action of electrolysis.

These solutions have been put to severe tests. Small crucibles about 3 in. high and ½ in. in diameter at the top, made from a porous clay were lined with the Triple A solution. In these crucibles, the following chemicals were placed: saturated solution of caustic ammonium fluoride; concentrated prussic acid; arsenious acid, and mercuric chloride. The crucibles were allowed to stand for two weeks after which the chemicals were removed. The acids and alkalies had not affected the Triple A solutions. There was no leakage through the porous clay which would have indicated at once that the solution had been eaten through by the chemicals.

A piece of 1/32-in. sheet steel was painted on both sides with the solution and after it had dried, was bent back and forth without showing signs of cracking or peeling.

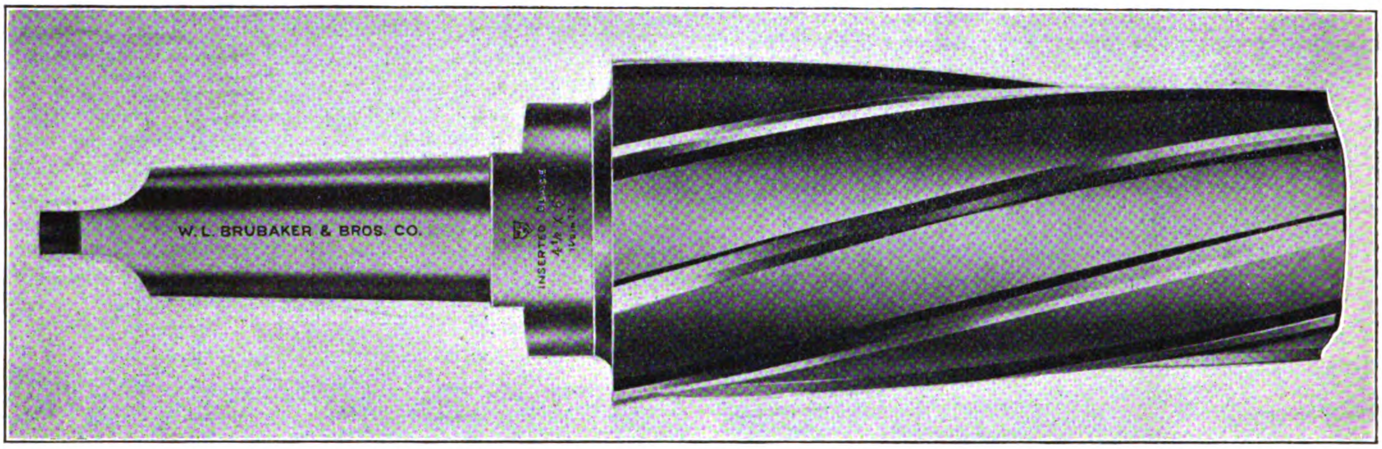
These solutions are applied with a brush on a clean metal surface, free from grease, dust or oil. They spread easily, leaving a firm, smooth and elastic surface. Triple A solutions are furnished in several colors, the usual standard base coat being black. Over this black may be applied additional Triple A colors, such as maroon, olive-green, deep-green, yellow, etc. The black solution will cover 300 to 400 sq. ft. of surface per gallon on iron or steel.

Spiral inserted blade reamer

WHEN the cutting edges of solid reamers are worn down to the point where they can not be reground, it is necessary to scrap the tool. This is a loss that can be reduced to a minimum by inserted tooth reamers. Such a reamer has been designed and placed on the market by the W. L. Brubaker & Brothers Company, 50 Church street, New York. The body of this reamer is made of a steel which can be subjected to abuse without any possibility of breaking or twisting.

The blades are made of high-speed steel and are heat treated so as to stand great strain without breakage. New blades can be furnished but as they are inserted by a special process, the reamer body should be sent to the factory for this work in order to obtain the best results.

The reamer can be obtained in any taper and size above 3 in. in diameter.



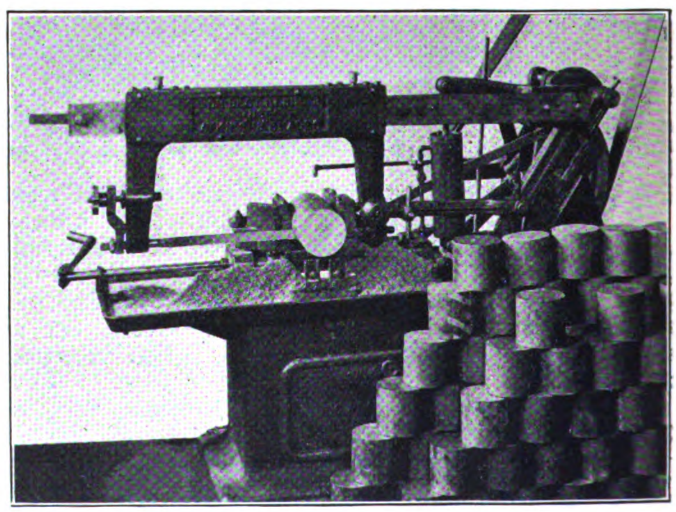
Brubaker spiral inserted tooth reamer

Atkins Silver Steel hacksaw blade

IT has been generally recognized among the users of power hacksaw machines that it has been impossible to obtain the maximum production from these machines as the average hacksaw blade will not stand up under high speed cutting. The E. C. Atkins & Company, Indianapolis, Ind., now manufactures a hacksaw blade which it is claimed will withstand the hardest service to which it can be put.

The success of the Silver Steel blades is attributed to the quality of the steel from which they are made. Another important quality of these blades is the heat treatment which they receive. As a result, each blade will give the same amount of service with a very small variation and with very little variation in the speed of the cut from the first to the last. The teeth are carefully milled with round gullets and properly pitched and are set even on each side of the blade. The performance of these blades is shown in the table.

Silver steel blade (new)			First Tungsten alloy blade (new)		
	Time			Time	
Piece No.	Min.	Sec.	Piece No.	Min.	Sec.
33	1	50	43	2	55
77	1	50	57	3	0
101	1	50	74	3	10
			Second blade		
127	1	50	1	2	25
150	1	50	25	2	30
184	1	50	44	2	55
205	1	50	67	3	25
215	1	50	79	3	50
			Third blade		
230	1	50	14	4	10
			Fourth blade		
250	2	0	5	3	5
288	2	0	41	6	55
			Fifth blade		
300	2	0	1	2	50
311	2	5	19	3	10
339	2	5	38	broke saw	
			Sixth blade		
356	2	5	17	2	40
400	2	5	52	3	30



Atkins steel blade cutting 4⅝-in. steel gear blanks

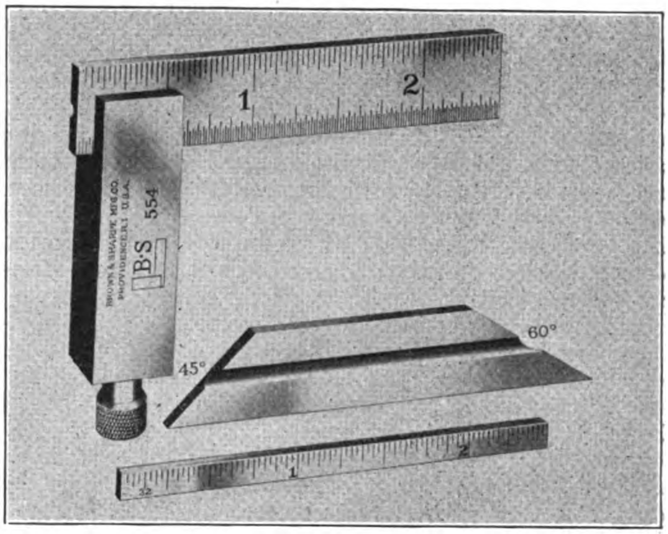
One Silver Steel blade made 400 cuts in the same time that the six blades of tungsten alloy steel made 298 cuts. The six tungsten blades averaged 49 cuts apiece.

Adjustable square with many uses

An adjustable square which can be used as a graduated square, as a depth and height gage, for laying out work, for grinding tools, particularly drills, for checking a mitre, for squaring up small slots, for testing a 60 deg. angle and for measuring the depth of counterbores or holes has recently been made by the Brown & Sharpe Manufacturing Company, Providence, R. I.

It is furnished with three blades. Referring to the illustration, with the wide blade, the tool becomes a graduated square or depth gage. This blade and the bevel blade are 24/64 in. wide. The bevel blade is suitable for grinding thread tools and laying out angles and mitres. It has both 60 and 45 deg. angles and is reversible. The narrow graduated blade which is 1/8 in. wide enables the mechanic to reach inaccessible spots. The clamping device holds the blade in the body firmly and accurately. The square is easy to use; simply insert the blade to the position desired and tighten the knurled nut.

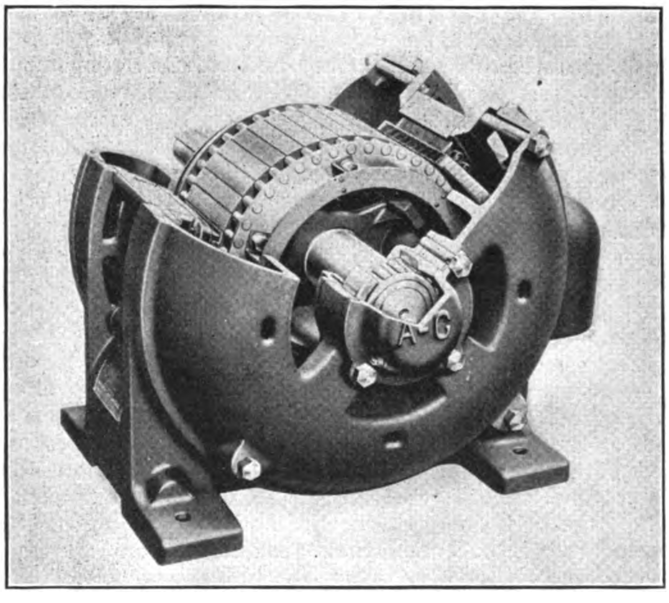
The blades are tempered and carefully ground and the graduations are clean cut and easily read. The body is hardened and ground.



Brown & Sharpe adjustable square with reversible blades

Roller bearing type motor

After two years of experimental and development work, the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has placed on the market a complete line of 25 and 60 cycle squirrel cage and slip ring induction motors equipped with Timkin tapered roller bearings. The Timkin bearing was selected only after very careful consideration of the many questions of design and operation. After designs of bearings and mountings had been made, a number of motors of various sizes were built and tested under actual operating conditions of belt, gear, chain and coupled drives, a sufficient length of time to insure satisfactory service. The Timkin bearing has been used because of its ability to withstand continued heavy radial and thrust loads without undue heating or appreciable wear. It is particularly suited to heavy service and will operate satisfactorily at the high speeds found in the general purpose induction motor. Because of the rolling action of the bearing, there is practically no wear so that the factory adjusted air gap is maintained indefinitely, eliminating any possibility of the rotor striking the stator.



Sectional view of Type AR roller bearing motor

The important question of lubrication is greatly simplified, as grease is used requiring very infrequent attention on the part of the operator. The bearings have grease tight enclosures effectively excluding dirt or abrasive matter that might cause undue wear of the bearings. The mounting of the bearings is very simple, being only a light press fit for both the cone and cup, and not requiring the use of a lock nut or other means of holding the races in place. This also facilitates the removal of the bearings whenever necessary.

In addition to the bearings, special attention has been given to many other features of design of this line of motors. The frame is made of steel with feet cast integral, to withstand shocks. The coils are thoroughly insulated and baked in a water-proof varnish. The openings in the housings and frames for ventilation are so placed in vertical planes, that falling objects cannot enter the motor.

This motor can now be obtained in all ratings, 25 and 60 cycle, 200 hp. and smaller.

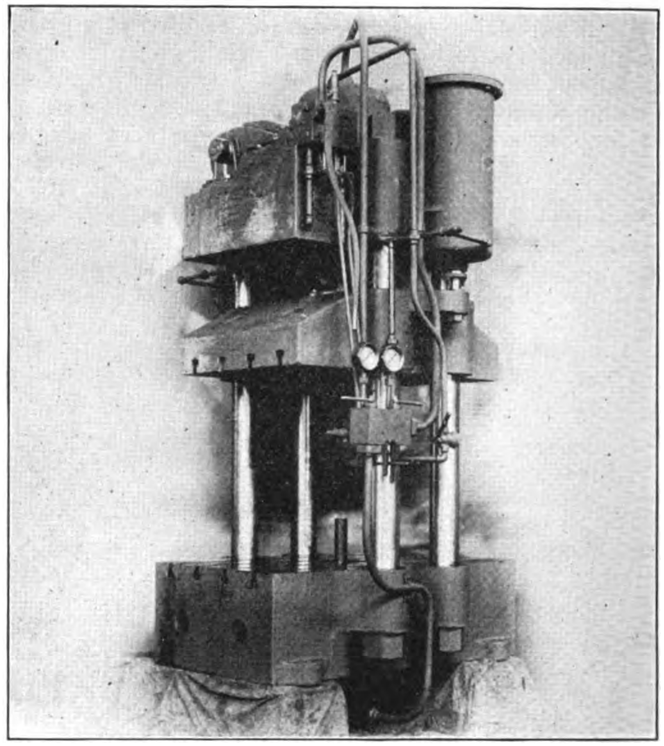
Testing a flanged tee.—Bulletin No. 2, recently issued by the Walworth Manufacturing Company, Boston, Mass., contains a complete description of a distortion test to a 4-in., 400-lb. working steam pressure, Walworth Sigma steel flanged tee made according to the American Engineering Standards Committee tentative standard dimensions. The tee was first submitted to an hydrostatic pressure test of 2,500 lb., after which the tee was fitted up with a 10-ft. length of 4-in. double extra-heavy pipe with a screwed steel flange on end, all of which was supported on 18-ft. centers. A total weight of 7,428 lb. was placed on the branch flange of the tee, which caused it to bend to the floor, or a total deflection of 27 1/16 in. The weight was removed permitting the pipe to spring back 4 3/16 in., leaving a permanent deflection of 22⅞ in. Finally the tee was again subjected to an hydrostatic pressure of 2,500 lb., which it withstood without any trouble.

Hydro-pneumatic press for railway shops

A SERIES of hydro-pneumatic presses designated as Model B, designed for railway shop use, have been placed on the market by the Chambersburg Engineering Company, Chambersburg, Pa. Exceptionally fast operation, complete accessibility of parts and ease of control enable these machines to meet the demands of the railway shop. The lighter presses are used for inserting and removing locomotive driving rod boxes and brasses, bushings, link hangers, bending and straightening levers and connecting rods, etc. The heavier capacity presses, one of which is illustrated herewith, are used for forming and pressing work in the steel car repair shop.

Fast operation is obtained by means of the hydro-pneumatic feature. The ram is brought down to the work by air pressure and the actual work is accomplished hydraulically under any pressure within the capacity of the machine. A large weighted pullback assures the fast return of the ram. The simplicity of the presses is achieved by mounting the motor, pump and crane on the top plates, thus giving free access to the press from all sides. The top plate also forms the water reservoir. The controlling valves are mounted on the side of the machines and so placed as to give the operator an unrestricted view of the work and the gages without changing his position.

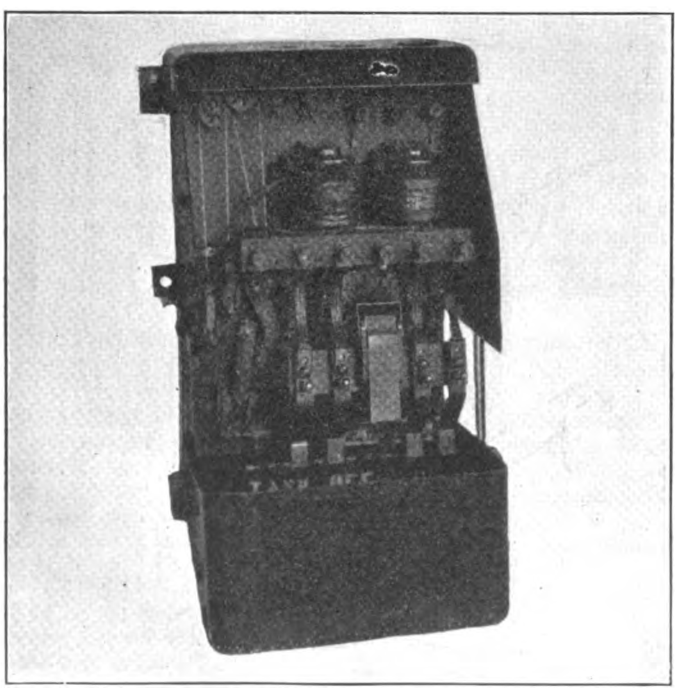
The machine shown in the illustration is a 300-ton, four-column press, provided with pneumatic pullbacks. Both the pressure ram and stripping ram advance rapidly to the work by pneumatic pressure, the actual work being completed by hydraulic pressure.



Chambersburg 300-ton hydro-pneumatic press

A push button starting switch

A PUSH button operated oil switch for starting squirrel cage induction motors directly across the line has recently been placed on the market by the Electric Controller & Manufacturing Company, Cleveland, Ohio. The device is known as the Type ZO starting switch and is controlled from one or more push button stations which may be located at convenient points. It is provided with four pairs of heavy contact fingers, three of which handle the main line in the case of three-phase or two-phase, three-wire motors, and the fourth pair handles the control circuit to the push button when the switch is arranged for no voltage protection. In the case of two-phase, four-wire switches all four lines are disconnected in the off position when the switch is wired for no-voltage release. When wired for no-voltage protection one line runs direct to the motor.



Push button operated oil switch for starting squirrel cage induction motors directly across the line

This switch uses an accurate inverse time element temperature overload device which consists of two alloy wires, each attached at one end to an adjusting screw and at the other end to a multiple lever which operates a quick make-and-break contact. The wire is connected across the secondary of a small current transformer. The gage of the expansion wire and the winding of the secondary of the transformer remain the same regardless of the horsepower ratings or voltage of the switch. The size of the wire and the number of turns of the primary is proportioned to suit the rating of the motor. An increase in current or an overload on the motor produces an increase in the current flowing in the secondary circuit, which causes the expansion wires to lengthen and, if the overload is severe enough or is of sufficient duration, the wires lengthen sufficiently to trip the overload relay contacts causing the starting switch to open and disconnect the motor from the line. The wires then cool and the overload relay contact automatically resets if a switch is wired for no-voltage protection. A

hand reset of the overload device by means of a small button projecting through the case is provided on switches arranged for no-voltage release.

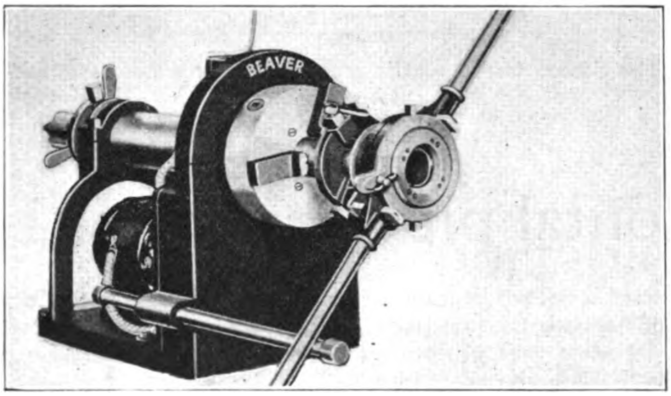
The overload device protects the motor against injury due to phase failure. If an attempt is made to start the motor with one phase open, the switch will open in less than five seconds, thus protecting the motor.

The oil tank will not leak as it is drawn from a single piece of sheet steel. The tank latches are arranged so that the tank can be lowered and left suspended to catch oil dripping from the contacts while the switch is being inspected. On account of the seepage of oil due to capillary attraction and from a slight splashing when the magnet surfaces engage, all moving parts of the switch are kept lubricated which protects the switch from corrosion when installed in corrosive atmospheres.

The switch is arranged for conduit connection and is of compact dimensions—13 in. high by 9 in. wide.

Portable power driven pipe threader

NO. 44 is the designation of a new portable electric machine recently placed on the market by the Borden Company, Warren, Ohio, for cutting and threading ¼-in. to 2-in. pipe, using any type or kind of hand operated die stocks or pipe cutters. A universal sliding extension shaft is furnished, however, to cut and thread up to 6-in. pipe, inclusive, using geared die stocks or cutters.



Borden portable power driven pipe threader with a capacity up to 6 in. inclusive

The operation of the machine is simple. The pipe is inserted and is rigidly held by a universal chuck. The die stock or pipe cutter is placed on the pipe as when cutting or threading by hand. The handle of the tool rests on a sliding bar at the side of the machine. When the current on, the pipe revolves while the tools stand still.

By using any type or kind of die stock or pipe cutter, this power drive virtually makes power machines of hand operated tools. It is also used to make up fittings in the machine, instead of by hand, thus performing a complete job of cutting, threading and fitting without removing the pipe from the machine.

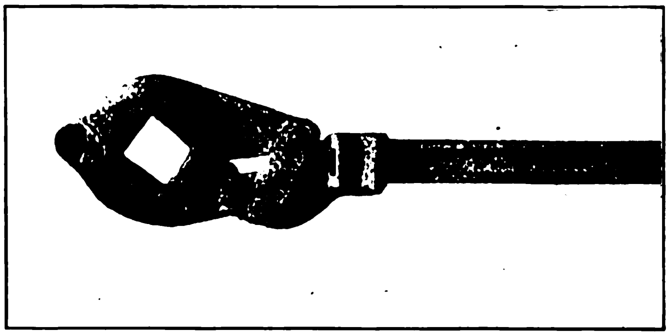
The machine is portable and weighs 230 lb. It is regularly equipped with a ½-hp. heavy duty, 110-220-volt, a.c., 60-cycle, single-phase motor and is operated from an ordinary light socket. Special motor equipment is available for localities where standard equipment is not suited.

Drop-bottom car door safety friction wrench

THE doors of hopper and drop-bottom cars are usually difficult to operate owing to the fact that they are subjected to considerable abuse in service. Consequently, much effort and time is required when dumping or winding up these doors. The Barrett Machine Company, Pittsburgh, Pa., has developed a wrench especially designed for this work, which it is claimed will function under all conditions with a minimum amount of effort and time.

The action of the wrench is secured through an arrangement of a toggle which gives a powerful tightening force in one direction only. The socket, which fits over the end of the car door shaft, is held between two straps which form the head of the wrench. These straps grip the socket when pressure is applied to the wrench handle. The toggle action insures instantaneous release so that the possible chance of the wrench injuring the operator by catching is reduced to a minimum. By the use of the toggle, there are no complicated parts to get out of order and no ball bearings, ratchet heads, pawls or triggers to catch.

No bolts are used in the wrench.



No bolts are used in the Barrett safety friction car door wrench

"Lanco" thread cutting die head

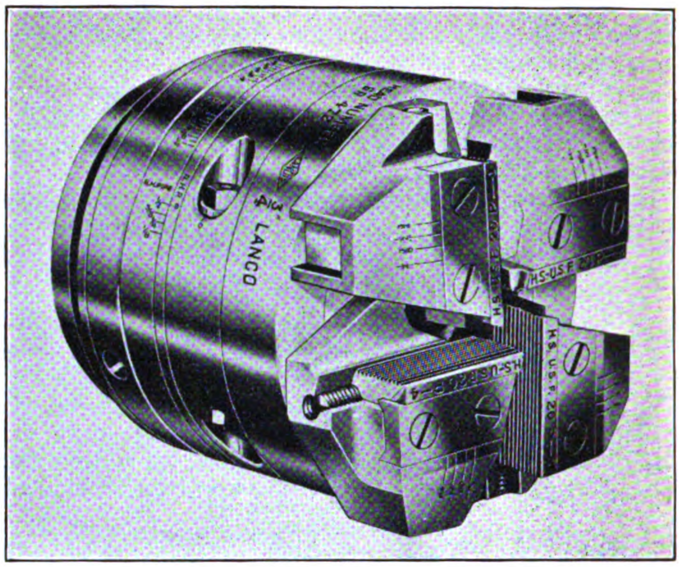
THE Landis Machine Company, Waynesboro, Pa., has placed on the market under the trade name of "Lanco" a new series of thread cutting die heads. The chasers are supported on the front face of the head, which permits easy access when it is necessary to remove them for grinding and when changing from one pitch to another.

The head is made of high carbon steel and is heat

treated throughout, and ground. This construction, together with the compact design of the head, reduces the wear to a minimum and prolongs the life. The head is adjusted to size by means of an adjusting worm. The adjusting worm is under the proper turning tension at all times, thereby eliminating the necessity of locking it for each adjustment of the die head for size. The graduated dial at the end of the adjusting worm gives a variation in adjustment of approximately .005 in. for each graduation. The head, when threading, is locked within itself by the engagement of two closing pins in hardened bushings. It is opened and closed automatically, which is always a desirable feature.

The head is graduated for all sizes of bolts, both right and left hand, and right hand pipe within its range. All passages and openings into the interior of the head are entirely covered under service conditions, making it impossible for dirt and chips to enter, thus prolonging the life of the head.

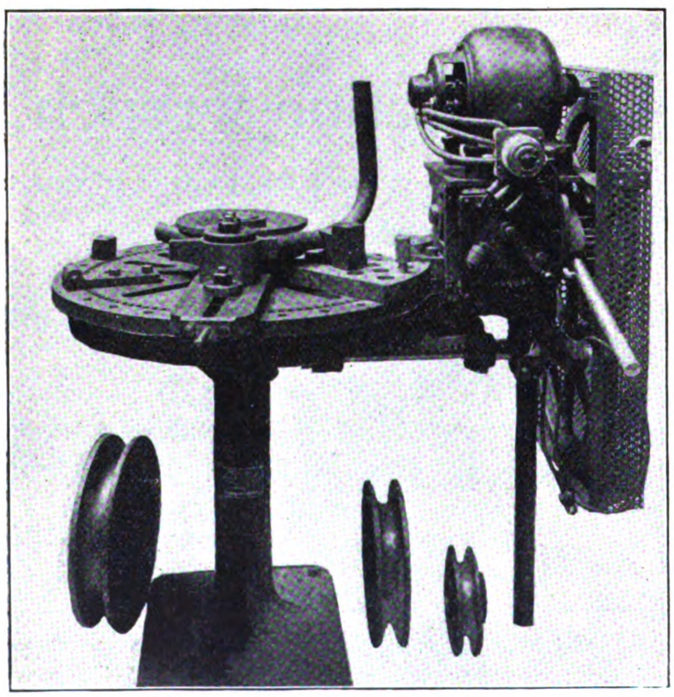
The head is made in the ⅜-in., 9/16-in., ¾-in., 1-in. and 1½-in. sizes. It is applicable to all makes of automatic, semi-automatic and hand operated threading machines.



The chasers can be readily removed from the Landis thread cutting die head

Motor driven horizontal pipe bender

HERETOFORE, the pipe benders manufactured by Pedrick Tool & Machine Company, Philadelphia, Pa., have been hand operated but since modern practice looks with more favor on power instead of hand work, this company is now building a pipe bender up to 2 in. in capacity which is especially designed for electric motor drive. A machine of this type is particularly adapted to railway work.



Power driven pipe bending machine with a capacity up to 2 in. inclusive

The face plate is geared to revolve within the cavity of the horizontal table so that the gear teeth are entirely covered and guarded. The bending roll, on the central stud, is bolted stationary and the bending arm, which moves with the face plate, bends the pipe around the roll. The other end of the pipe rests against a small saddle located on the resistance arm. This latter piece has a free radial movement which is held, wherever desired by a dowel pin in holes located in a circle around the face of the table.

This provides an important application because the bending arm and the resistance arm may be brought close together for the purpose of bending short pieces of pipe that have been cut off and, perhaps, threaded. A stop, which is bolted to the face plate, is provided so that any quantity of the same shape may be bent with the assurance that each piece is subjected to a uniform bending movement and consequently will register with the preceding bend when the stop makes contact with a pin suitably located in the holes spaced around the edge of the table.

From this it will be seen that from one size roll almost any shape may be obtained. The roll is grooved for the diameter of the pipe to be bent and governs the radius of the bend. The arc through which the face plate is turned, controls the degree or angle of bend. Hence, a right angle bend is made by revolving the face plate 90 deg., a larger or smaller angle is as easily made accordingly.

In the power driven machine the motor is allowed to run while the machine is in operation and the hand lever affords start, neutral and reverse positions instantly at the wish of the operator. The power drive serves a very useful purpose when quantities of the same shape are to be bent. It works at a uniform speed and without decreased production or the efficiency of the operator at the end of the day.

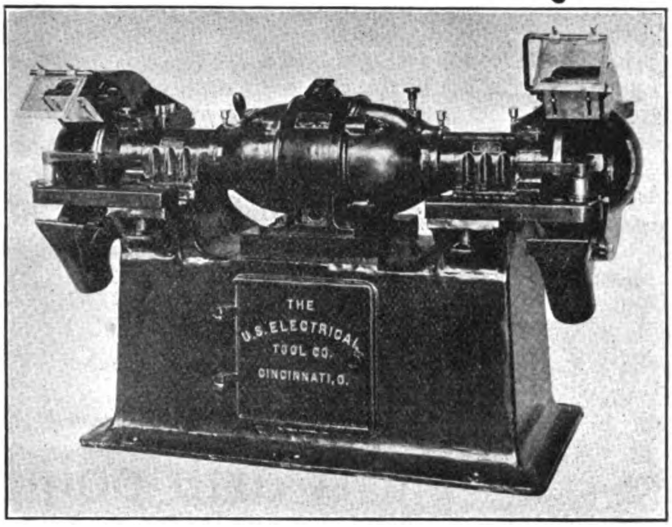
The horizontal table is convenient on which to handle, lay out and measure the work and also permits the bending of long pieces at the middle of the length which is often necessary in hand-rail work, running pipe lines, etc.

Besides the 2-in. power driven machine the manufacturer makes also a hand machine of the same capacity and smaller.

Heavy duty constant speed grinder

A HEAVY duty adjustable speed grinder, suitable for either alternating or direct current, has recently been placed on the market by the United States Electrical Tool Company, Cincinnati, Ohio. These grinders are so designed that the adjustment of the guards of the wheel will automatically regulate the speed of the motor so that the peripheral speed of the wheels is constant regardless of the wheel diameter. When used on direct current, constant peripheral speed can be obtained regardless of the wheel size.

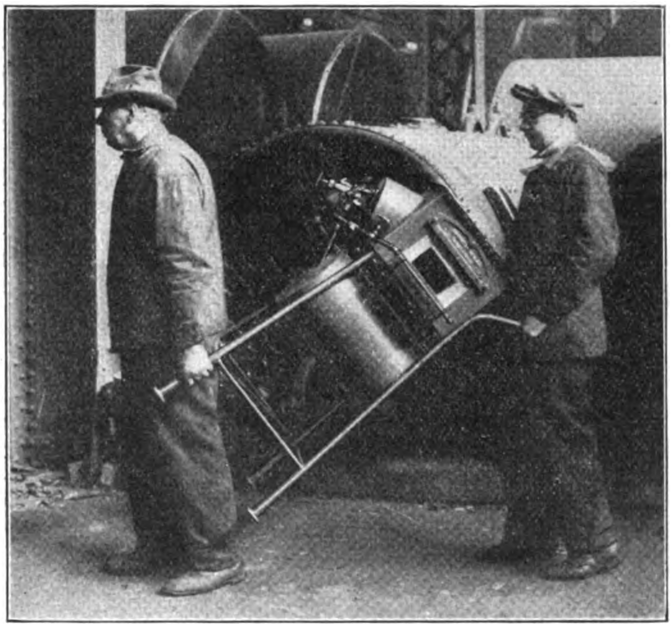
On alternating current, starting with a 24-in. wheel at 900 r.p.m., a periphery of approximately 5,500 ft. is obtained. The wheel can be used until it is worn to 18 in. at which time the next speed of 1,200 r.p.m. will automatically cut in by moving a hand lever which will then bring the periphery up to approximately 5,500 ft. Another change in speed occurs when the wheel is worn to 12 in. which increases the speed of the motor to 1,800 r.p.m. which will then again bring the speed up to approximately 5,500 ft. The alternating current motor on these machines is a three speed motor namely: 900, 1,200 and 1,800 r.p.m.



Constant speed grinder for use with alternating or direct current motors

Light portable oil rivet furnace

AN oil burning, hand portable rivet forge for shops and yards where a forge can be carried most conveniently, has been placed on the market by the Johnston Manufacturing Company, Minneapolis, Minn. It is equipped with the Johnston non-clogging vacuum oil burner, a description of which appeared on page 501 in the August, 1924, issue of the *Railway Mechanical Engineer*.


The Johnston oil rivet furnace can be carried by two men

The hearth of this forge is 40 in. above the floor so that the operator can see the rivets without stooping. The gases from the heating chamber are vented high enough so that they can not be blown by the wind against the workmen. The closed top chamber provides good combustion as the vent gases leave the bottom or coolest part of the heating chamber. The heating chamber is designed to give a rapid motion to the gases which come in contact with the rivets. This chamber is lined with standard sizes of fire brick and is made thicker at the points of maximum temperature. The frame is made of pipe and welded together which gives a minimum weight in proportion to the strength. It is also designed so that it can be readily carried from one job to another by two workmen.

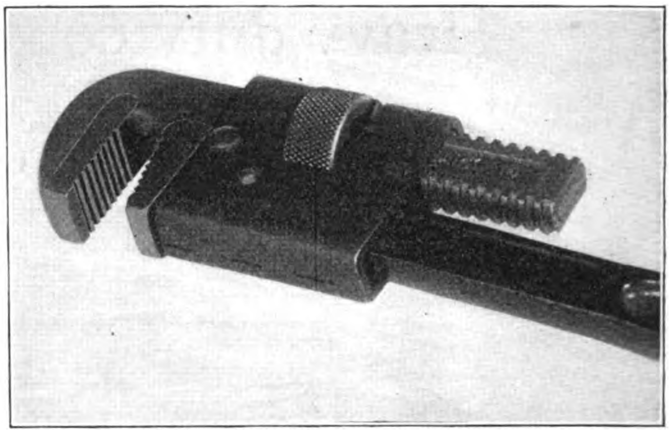
The furnace operates on compressed air between 60 to 125 lb. and burns either kerosene, distillate or fuel oil. It uses six cubic feet of air per minute and burns one gallon of fuel per hour. The fuel tank capacity is 7½ gal. per hour. The heating chamber is 8½ in. by 10 in. and its charging opening 5½ in. by 3½ in. It requires a floor space of 20 in. by 36 in. and weighs 240 lb.

All-steel pipe and monkey wrench

AN all-steel pipe and monkey wrench which has been introduced recently for use in railroad shops and enginehouses is illustrated. Features of this wrench are its construction of accurately machined drop forgings and the application of a removable lower wrench jaw held in place by a thumb screw. The construction is such that the lower jaw pivots slightly on the screw and this movement in conjunction with that of the hook jaw, gives a double action which assures an unusually rigid grip on round pipe or other similar material being turned against resistance. There is a noticeable tendency for the jaws to grip harder the harder the pull, and yet they re-

lease readily as soon as pressure is removed from the handle. Owing to the fact that in operation the jaws adjust themselves so as to be practically parallel, the tendency to crush the pipe is minimized. Another feature of this wrench is the absence of any handle or bridge springs to become lost or broken. The material and rugged construction of the frame are designed to give the wrench long life in the severe service to which wrenches are subjected in railroad shops and enginehouses.

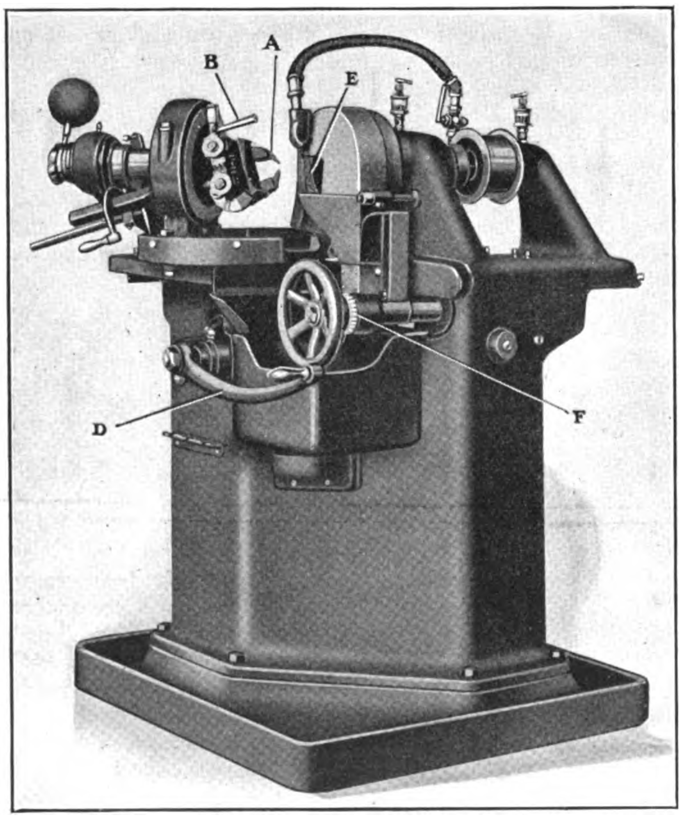
When used as a monkey wrench, the hook jaw is furnished without teeth and a plain inserted main jaw is also applied. For use on pipes, this wrench is provided in 8, 10, 14, 18, 24 and 36-in. sizes, the largest taking 3½-in. pipe. The monkey wrench sizes are 8, 10, 14 and 18-in. All parts of the monkey wrench are interchangeable with the pipe wrench. This wrench is made by the Larco Wrench & Manufacturing Corporation, Chicago.



Larco all-steel wrench with double-acting jaws

Twist drill point grinding machine

A TWIST drill point grinding machine built in two sizes, No. 2 taking drills ¼ in. to 7/4 in. in diameter, and No. 3 taking drills ⅝ in. to 2 in. in diameter, is now manufactured by the Union Twist Drill Company, Athol, Mass. It will sharpen points of twist drills having right-hand spiral flutes and two lips, and will grind them so that the cutting point will have lips that are the same length, with the chisel point coming at the center of drill.



Union twist drill point grinder which will sharpen all types of drills up to 2 in. in diameter

The drill is held by a two-jaw chuck *A*, operated by the lever handle *B*, which gives a rapid movement of the chuck jaws, thus taking a minimum amount of time in chucking the work. The chuck jaws are adjustable laterally so as to give them a clearance angle for different diameters of drills. A graduated plate on the upper jaw gives the setting for different diameters. The jaws can be adjusted vertically to obtain different clearance angles as required. The machine is adjusted, when assembled, to give a clearance angle of 12 deg.

The work spindle is carried in a housing that is adjustable to give various included angles of drill points ranging from 90 deg. to 118 deg. The machine is set to give a 118 deg. included angle of point which has been found to be most efficient for general work.

The work spindle housing is carried by a slide operated by the hand lever *D* so that the point of the drill is moved across the face of the grinding wheel. This slide travels on hardened and ground roller bearings, which permits rapid traverse with a minimum amount of effort on the part of the operator.

The chuck spindle front bearing is carried on hardened and ground steel rollers, and the rear bearing is carried in a bronze box adjustable for wear and adjustable longitudinally so that chuck and spindle can be kept in a correct position relative to the spindle boxes. The chuck spindle has a rotary movement of about 110 deg. and can be varied by setting adjustable screws.

The grinding wheel *E* is of the ring type, 8 in. in diameter, and is held by a flange clamped to the end of the wheel spindle. The wheel head has an adjustment of 4-in. to compensate for the wear of the wheel and allow for moving the wheel to the correct position in relation to the drill. A graduated collar *F* on an adjusting screw provides means for moving the wheel to the same position for grinding both lips of a drill.

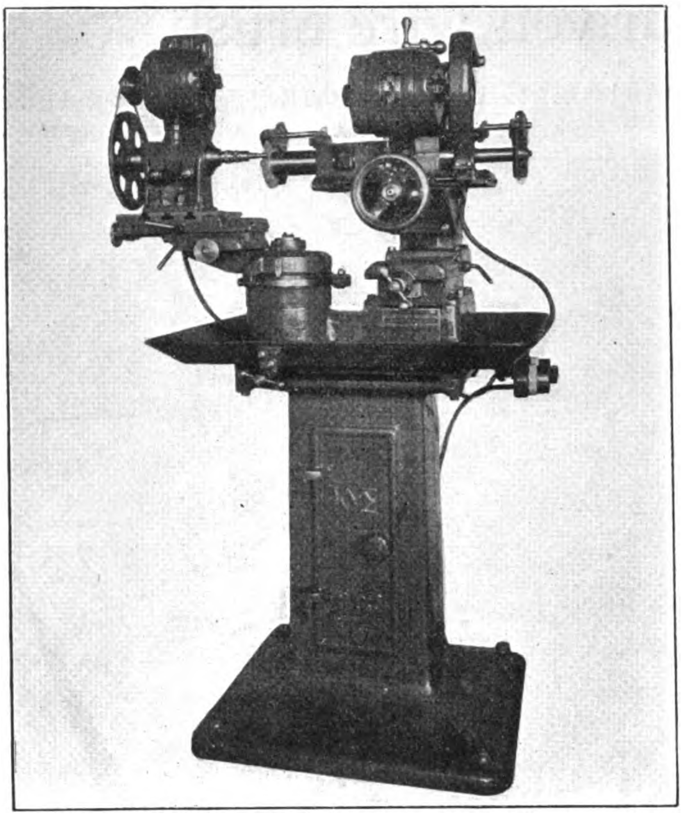
All drills, both high speed and carbon, should be ground wet with an ample supply of water on the work. A pump and tank with suitable piping is provided and supplies a sufficient flow of water to the wheel. The machine is equipped with suitable water or splash guards to protect the workmen.

A diamond holder is clamped in the chuck jaws in the same manner as a drill is clamped, and is traversed across the face of the wheel. This insures that the cutting face of the wheel is parallel with the travel of the drills when they are held in the chuck.

The countershaft has tight and loose pulleys 10 in. in diameter for a 3-in. belt and should run 550 r.p.m. The floor space required for the machine is 45 in. by 40 in. The net weight of No. 2 is 1,580 lb. and No. 3 1,850 lb.

Universal cutter and radius grinder

THE cutter and radius grinder illustrated has been placed on the market by the Keller Mechanical Engineering Corporation, Brooklyn, N. Y. The machine is intended for grinding milling cutters, reamers and similar tools, and is suited for spherical and radius, cylindrical, taper, face, angular form, flute and blade, clearance and back-off, internal and various surface operations.



Universal grinder especially adapted for shaping milling cutters

There are six separate movements on the machine, giving a wide range of adjustments and adaptability to many classes of work. It is possible to grind a desired radius on an end mill or on the corner of a face mill, at the same setting used for the rest of the grinding of the cutter.

The machine is self-contained, driven by two motors, one for the wheel drive and one for the work drive, and it has a spindle speed of 5,100 r.p.m. The ball-bearing wheel spindle is mounted on three slides, giving movement longitudinally, vertically and transversely of 4¾ in. each. The work-holding stretcher is mounted on a turntable so that it can be swung with relation to the wheel in order to grind the radius of the work. A cutter-grinding fixture is furnished for holding mills of all types, and for grinding the tracer points and similar work the cylindrical and face-grinding fixture, equipped with a motor, is provided. Five work speeds are adjusted to suit the work, by means of cone pulleys. The work table travel is 210 deg. angular, 3¾ in. radially and 1⅞ in. cross-slide. The size of the table is 6⅜ in. by 8½ in., and it is provided with three ½-in. tee-slots.

The cutter head can be tilted 45 deg. in either direction and the spindle of the work-holding attachment can be swiveled in a vertical plane and locked in any desired position. The wheels used are ⅜ in. by 4 in. and ⅛ in. by 4 in., either cup or saucer.

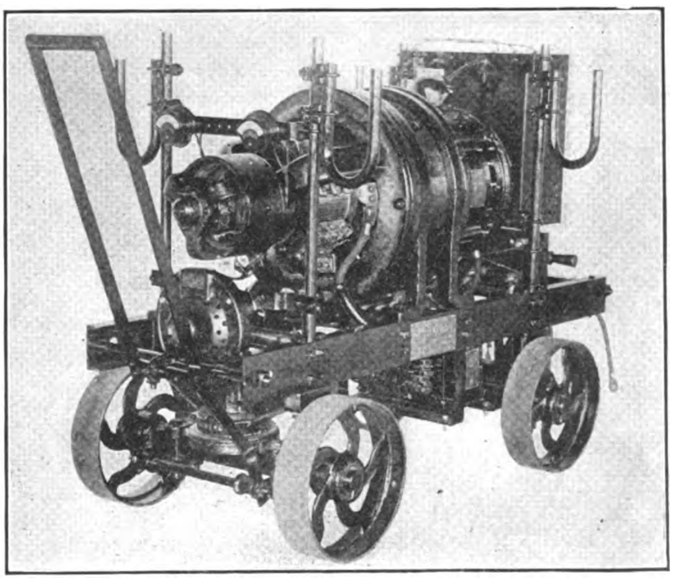
The overall height of the machine is 60 in., and the floor space required is 44 in. by 40 in., the net weight is 800 lb. and, crated for shipment, 875 lb.

Interpoles added to welding generator

THE USL welding generator, manufactured by the U. S. Light & Heat Corporation, Niagara Falls, N. Y., in 200 and 300 ampere capacities is a four-pole self- and separately-excited shunt machine with an all laminated magnetic structure. This type of construction permits a rapid change of magnetism so that the arc will respond quickly to the varying conditions and adjust itself to any demand. Each main pole is provided with two shunt field windings. One set of field coils receives current from a small exciter generator, while the other set is connected to the brushes of the welding generator. The effective flux is produced by the combined action of the self- and separately-excited fields.

In order to provide perfect commutation under severe service conditions the USL 300 ampere arc welder is equipped with four commutating poles. With the addition of these commutating poles perfectly black commutation at any load up to 350 amperes is assured. Maintenance cost and brush wear are therefore a minimum.

The feature of good commutation on machines with variable and fluctuating loads is of utmost importance in view of the fact that instantaneous inherent regulation is most effective on machines with smooth commutators. Another advantage gained through interpoles is the slight compounding action of the interpole flux which results in a steadier and more tenacious arc. This feature will be appreciated by all engineers experienced in the art and application of arc welding. The last advantage is the inherent arc current stabilizing action of the interpole



U. S. L. portable welding outfit

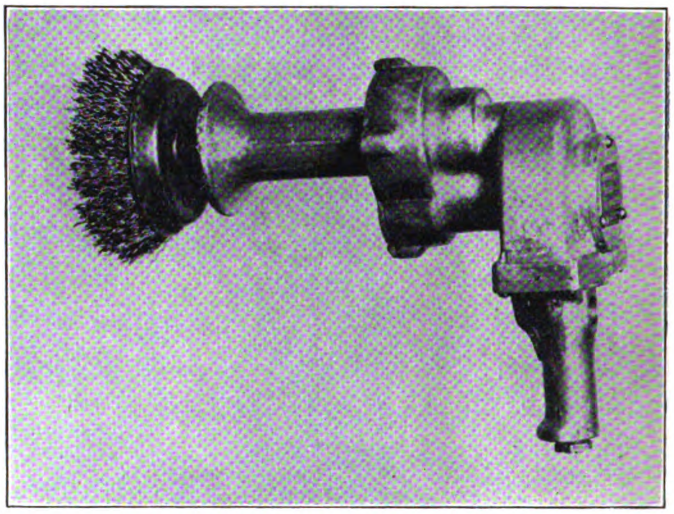
windings. As the interpole windings, being connected in series, always carry the full welding current, a very pronounced internal reactance is set up and to such an extent that under certain conditions the usual external stabilizer may be eliminated. This latter advantage is of decided importance in so far as a reduction in size or the entire elimination of the external reactance results in a higher over-all efficiency of the welding equipment.

Pneumatic turbine-driven wire brush

A PNEUMATIC turbine-driven cable brush for use in cleaning rust preparatory to painting tank and steel freight cars has been placed on the market by the Standard Turbine Corporation, Scio, N. Y. The turbine consists of a wheel operating at a speed of 12,000 r.p.m. mounted on ball bearings and geared to the low speed shaft driving the wire brush.

The low speed shaft is laid in a long sleeve bearing and arranged also with a ball thrust bearing to take up any thrust imposed in applying the brush. The air is admitted to the turbine wheel by means of a valve operated by a trigger. The turbine wheel itself consists of a small steel forging tested to a maximum speed of 100,000 r.p.m. The bearings are grease lubricated, the grease connections being arranged for the alemite system. The exhaust is through the center of the low speed shaft, which assists in keeping the brush clean.

The standing torque of the motor is claimed to be greater for equivalent air consumption than any reciprocating motor used for this kind of work. The no-load speed of the motor is always such as to be less than one-third of the tested safe speed of the wheel. The motor has an all aluminum casing and its total weight is 9¼ lb. without the brush and about 11 lb. with the brush. The motor is free from vibration.



Turbine driven wire brush for cleaning steel cars and tanks

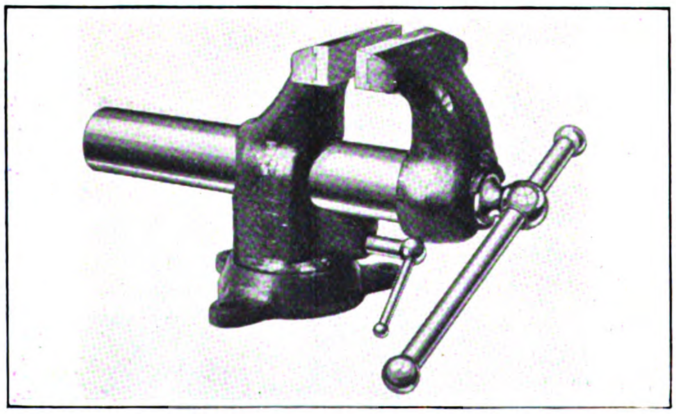
Steel drop forged bench vise

UNDER the trade name of "Dropfo," a vise that is made entirely of drop forgings, has recently been developed by the Fulton Drop Forge Company, Canal Fulton, Ohio. It contains no cast iron parts.

Each part is machined to be interchangeable with the same part on any other vise of the same size. The jaw plates are knurled and forged under the hammer and doweled onto the jaw. Thus, it is possible to replace the jaw plates, which are naturally subject to wear.

The vise is lighter in weight than the cast iron type. It is made with a swivel base and wedge lock that is quick to set and automatic in tightening up, and has a grip that is hard to shake or break loose.

It is made in four sizes: 3 in. with jaws opening 5½ in.; 4 in. with jaws opening 6 in.; 5 in. with jaws opening 8 in., and 5 in. heavy duty with jaws opening 8 in.



A bench vise made of steel drop forgings

Steel and its heat treatment.—The first of a series of articles on steel and its heat treatment, by H. M. Boylston, has been issued by the Republic Flow Meters Company, Chicago. This article gives the reasons for heat treatment; heating and cooling curves of pure iron showing the solidification temperature of iron and the critical temperatures, and inverse rate curves showing the critical temperatures of pure iron.

Portable electric twist drill grinder

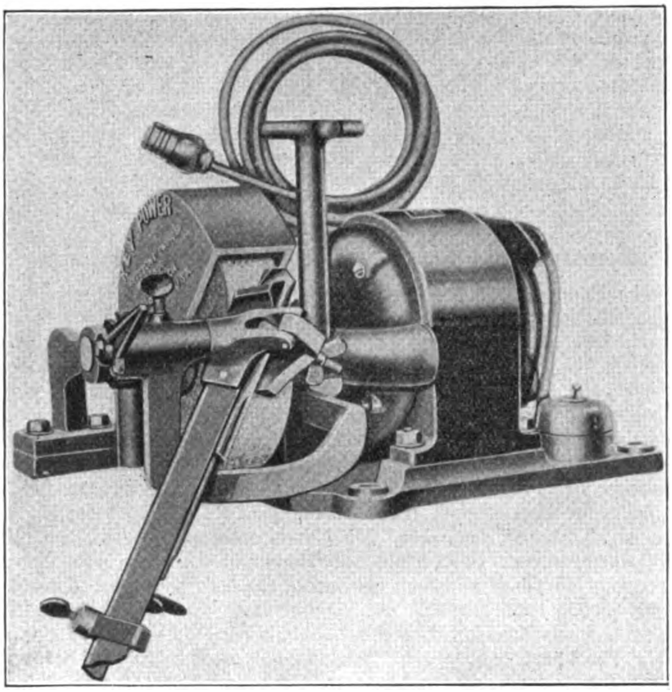
A NEW portable electric twist drill grinder has been designed to produce efficient work at a rapid rate with unskilled workmen. This device, called the "Key-power," is manufactured by the Keystone Grinder & Manufacturing Company, Pittsburgh, Pa.

The grinding action is produced by a light pressure of the drill against the face of the grinding wheel which permits rapid work and prevents burning of the steel or drawing the temper of the tool. The tool or drill is held firmly in place by means of a wedge-shaped toolholder that assures uniform results and eliminates the uncertainty of hand application. No water is necessary during the

grinding process since there is a continuous air circulation on the face of the wheel which contsantly keeps the tool cool.

Railroad repair shops and yards should find this device particularly useful due to its portability; the machine weighing only 60 lb. With it the tools can be ground on the job. A heavy hood over the grinding wheel gives ample protection to the operator.

This electric grinding device is driven by a Westinghouse ¼-hp. motor. An attachment cord enables the machine to be plugged into any ordinary socket. It is capable of redressing all shapes and kinds of edged tools and is fitted for grinding ¼-in. to 1½-in. drills.



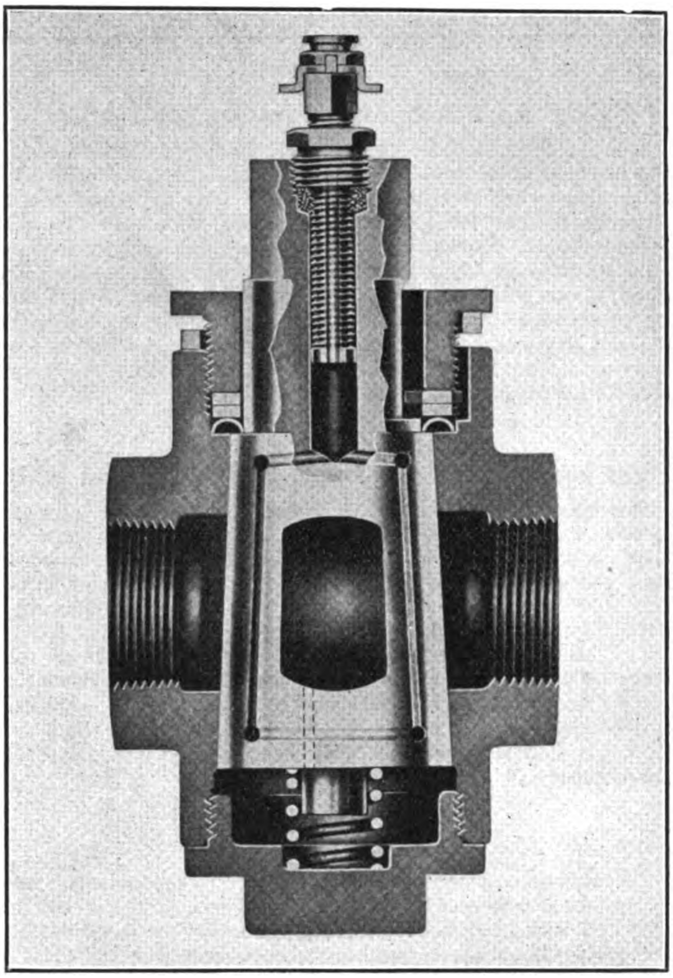
Portable electric twist drill grinder which can be operated by an unskilled workman

Lubricated plug valve

MODIFICATION of a plug valve which was first described on page 1415, in the June 11, 1924, Daily Railway Age, specially designed for steam, air, water, gasoline, kerosene and fuel oil lines in coach yards, general repair shops, enginehouses and terminals, has recently been placed on the market by the Barco Manufacturing Company, Chicago. One-quarter of a turn gives a full pipe area opening through the valve. Since no valve stem is used packing maintenance and sprung or bent stems are eliminated.

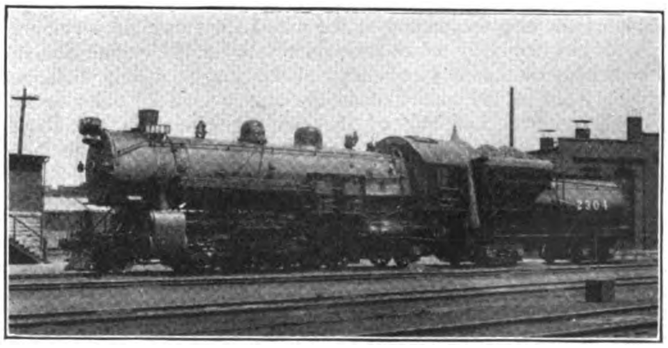
The valve is provided with a grease reservoir and lubricating passage ways, as indicated in the accompanying illustration. A lubricator is provided in the plug which prevents the escape of the grease and provides the feeding of the grease to the surfaces of the valve as required. Owing to this feature, the plug and plug seat hold the pressure tight, and the valve operates with ease. The fact that the valve and seat are lubricated at all times greatly reduces wear and replacement. The lubricant may be purchased in tubes ready for use which is usually applied by means of a Barco lubricating gun. If, however, a gun is not available, the grease may be rolled in candle form and applied by hand, after first removing the lubricator.

The valves are ordinarily furnished with handles or wrenches, or they may be operated with an ordinary monkey wrench. If wrenches are desired, they may be obtained in either the standard wrench or the cross wrench. The latter is furnished for valves that are placed in overhead lines, so that they may be operated from below by a slight pull on the opening or closing chains attached to the ends of the handle.



Barco Type AC1 lubricated plug valve which opens fully with one quarter turn

The Type AC1, which is illustrated, will carry the following pressures: Steam, 150 lb.; water, 300 lb.; air, 150 lb. The temperature must not exceed 400 deg. F.



Union Pacific locomotive No. 2304 ready to leave the enginehouse, Cheyenne, Wyo.

General News

Safety Appliance Act—defective hand brake

A brakeman took hold of the wheel of a hand brake to help him to climb to the top of the car to release the brake, when the brake, due to a defect, became loose and spun the wheel round, throwing him to the ground. The Circuit Court of Appeals, Second Circuit, holds that if the brake was incidentally used in going to the point where it was to be released by turning the hana wheel, it was within section 2 of the Safety Appliance Act requiring efficient hand brakes on cars, and the fact that the brakeman was not then using the brake for the purpose for which it was intended did not defeat his right to recover.—Lehigh Valley v. Howell, 6 Fed. *2d*) 784.

Large equipment orders placed by N. Y. C. and M. P.

The New York Central has ordered 4,500 freight cars as follows: 2,000 box from the American Car & Foundry Company; 1,000 gondola from the Pullman Car & Manufacturing Corporation; 500 gondola from the Illinois Car & Manufacturing Company; 500 gondola from the General American Car Company; and 500 gondola from the Standard Tank Car Company.

The Missouri Pacific has ordered 3,000 freight cars as follows: 1,000 box, 250 hopper and 250 furniture from the American Car & Foundry Company; 500 box from the General American Car Company; 500 box and 250 automobile from the Standard Tank Car Company; and 250 stock from the Pennsylvania Tank Car Company.

Cost of locomotive fuel

The average cost of coal used as fuel for road locomotives and charged to operating expenses in August was $2.66 per ton, as compared with $2.95 in August, 1924, according to the Interstate Commerce Commission's monthly statement, covering 159 Class 1 railways, excluding switching and terminal companies and switching locomotives. Fuel oil, however, cost 3.23 cents per gallon as against 2.86 cents last August and the total cost of coal and fuel oil for the month was $26,305,785 as compared with $26,375,435 last August. For the eight months ended with August 31 the total cost of coal and fuel oil was $214,736,375, as against $237,750,593 last year, a saving of approximately $28,000,000 in coal being offset in part by an increase of approximately $5,000,000 in fuel oil.

Record run by oil-electric rail car

On November 4 one of the new oil electric cars of the Canadian National completed a run from Montreal, Que., to Vancouver, B. C., a distance of 2,937 miles in 67 hours. This is the fastest time on record for the run between these points and during the whole of the trip the engine of the car did not once stop running.

Arranged primarily as an endurance test for the engine, the run proved also the speed possibilities of the car over long distances. At one point in Western Canada the car covered 22 miles in less than 22 minutes and one of the steepest grades in the Rocky mountains was climbed at an average speed of 40 miles an hour. The average speed for the entire trip was slightly under 44 miles per hour. This car was described in the November *Railway Mechanical Engineer*.

Wage statistics for August

A summary of the reports of Class I railroads to the Interstate Commerce Commission indicates that the number of railroad employees and the total compensation were greater in August, 1925, than in any month since October, 1924. The total number of employees was 1,800,219, an increase of 4,550 or 0.3 per cent over the returns for the previous month. The total compensation increased $1,371,967 or 0.6 per cent. Compared with August last year there was an increase of 0.6 per cent, while the total compensation increased 3.2 per cent. The percentage difference between the employment and compensation is due to an increase in the number of hours worked per employee coupled with an increase of 0.6 cents in the straight time hourly earnings and 1.5 cents in the overtime earnings.

Pennsylvania announces fuel contest winners

The Pennsylvania has just announced the winners of the highly successful contest for the best paper on fuel conservation which closed last month. There were 75 entrants in the contest, which was open to locomotive enginemen and firemen employed in any one of the three regions of the Pennsylvania. The contest was close in all regions and the committee which had charge of selecting the winners reported that it was difficult to make their decision because all of the papers were interesting, well-written and gave evidence of study and interest in the subject. There were three winners in each region, those in the Eastern region being first, R. H. Thomson, engineer, Maryland division; second, H. P. McLane, fireman, Philadelphia division; and third, J. W. West, fireman, Maryland division. In the Central region the winners were first, John Bruce, Sr., engineman, Panhandle division; second, F. L. Lievig, engineman, Pittsburgh division, and third, C. F. Lockhart, engineman, Pittsburgh division. The winners in the Western region were first, R. W. Karns, engineman, Cincinnati division; second, G. R. Cooper, fireman, Cincinnati division, and third, N. A. Gibson, engineman, Indianapolis division.

American built locomotives popular in South Africa

Record crops this year have found the South African Railways so inadequately equipped with rolling stock and motive power that some of the expresses running between Johannesburg and the coast have had to be temporarily suspended, and the big Baldwin engines recently making new records for the 1,000 miles run have been transferred to the fast freight service, says the Johannesburg correspondent of the Times (London) Trade Supplement. In the effort to relieve the shortage 15 additional locomotives have been ordered from the Baldwin Locomotive Works. Of these 15 new locomotives ten are to be of the Mountain type and five of the Pacific type.

Two of each of these types have been running on the South African Railways for over a month. They were ordered by the Administration on December 15 last. As far as is consistent with South African conditions these locomotives embody the latest American practice.

With the order for the 15 additional locomotives in course of construction at Philadelphia, the Baldwin Locomotive Works will have supplied 79 locomotives to the South African Railways. The first order was placed in 1892. The railways have now 1,862 locomotives and 34,362 cars, an increase since 1909 of 451 locomotives and 11,795 wagons. A total of 54 locomotives are on order, and every month will witness a substantial increase in the capacity of the system for handling the huge traffic with which it now has to cope.

Meetings and Conventions

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 9-16, inclusive, Young's Million Dollar Pier, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York. Next meeting, June 9, 10 and 11, Atlantic City.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting, December 8. Paper on inspection of material for railway purposes will be presented by R. Job, vice-president, Milton Husey Co., Montreal.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Courtlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August. Hotel Statler, Buffalo, N. Y. Next meeting December 3. Paper on best means of promoting friendly relations between the public and railroads will be presented by Harry F. Burber, plant manager, National Aniline Company, Buffalo. G. C. Woodruff, assistant freight manager, New York Central, Buffalo, will handle the subject from the viewpoint of a railroad traffic officer and R. E. Woodruff, superintendent, Erie, Buffalo, from that of a railroad operating officer.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Cleveland, Public Square, Cleveland. Next meeting December 7. Paper on the value of man power will be presented by S. F. Fannon, Sherman Service, Inc.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchison, 1809 Capitol Ave., Omaha, Neb. Next meeting May 11-14, 1926, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Courtlandt St., New York. Next meeting May 25-28, 1926, Hotel Statler, Buffalo, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting December 8. Paper on comparative merit of steam and electricity in railroad operation will be presented by L. K. Sillcox, general superintendent of motive power, Chicago, Milwaukee & St. Paul.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Courtlandt St., New York. Meeting third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 625 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, castor, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August. Next meeting December 11. Papers on the general subject of railroads will be presented by James C. Davis, director general of railroads, and by C. C. Cook, chairman of the Committee on Economics of Railway Labor of the A. R. E. A. Christmas entertainment.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern Railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 226 W. Jackson Blvd., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Purchases and Stores meeting

The 1926 annual meeting of Division VI—Purchases and Stores, American Railway Association, will be held at Atlantic City, N. J., on June 9, 10 and 11, coinciding with the first three days of the meeting of Division V—Mechanical. The headquarters of the Purchases and Stores Division will be announced later.

Locomotives installed and retired

	Installed during month	Aggregate tractive effort	Retired during month	Aggregate tractive effort	Owned at end of month	Aggregate tractive effort
January, 1925	167	7,455,971	213	6,242,079	64,824	2,590,525,478
February	125	6,233,494	169	5,118,878	64,779	2,591,618,849
March	138	6,249,721	170	4,888,933	64,747	2,592,979,637
April	171	7,498,252	409	13,126,135	64,509	2,587,347,354
May	147	7,930,840	172	5,329,461	64,484	2,589,912,779
June	179	9,746,100	224	8,296,659	64,435	2,591,286,720
July	139	7,208,534	170	5,602,619	64,420	2,593,971,635
August	147	8,384,262	210	5,866,368	64,357	2,596,489,549
September	129	7,981,464	229	8,601,871	64,257	2,595,729,142
Total for 9 mos.	1,342	....	...	....	......	....

Figures as to installations and retirements prepared by Car Service Division, A. R. A., published in Form C. S. 56 A-1. Figures cover only those roads reporting to the Car Service Division. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

Passenger cars installed and retired

Quarter	No installed during quarter	No. retired from service during quarter	No. owned or leased at end of quarter
Full Year, 1923	2,719	2,713	......
1924			
Jan.-March	699	431	54,519
April-June	698	552	54,668
July-September	668	544	54,783
Oct.-December	759	849	54,787
Full year, 1924	2,824	2,376	......
1925			
Jan.-March	609	589	54,594
April-June	690	644	54,658
Total for 6 months	1,299	....	......

Figures from Car Service Division, A. R. A. quarterly report of passenger cars, Form C. S. 55 A. Figures cover only Class I roads reporting to Car Service Division.

Freight car repair situation

Month	Number freight cars on line	Cars awaiting repairs: Heavy	Light	Total	Per cent of cars awaiting repairs
January 1, 1925	2,293,487	143,962	47,017	190,979	8.3
February 1	2,305,520	139,056	47,483	186,539	8.1
March 1	2,313,092	141,192	43,855	185,047	8.0
April 1	2,315,732	143,329	43,088	186,417	8.1
May 1	2,316,561	144,047	45,467	189,514	8.2
June 1	2,320,261	146,998	48,988	195,986	8.4
July 1	2,326,734	150,530	47,938	198,468	8.5
August 1	2,335,223	153,674	43,607	197,281	8.4
September 1	2,333,849	149,705	47,473	197,178	8.4
October 1	2,335,475	139,551	40,020	179,571	7.7

Month	Cars repaired: Heavy	Light	Total
December, 1924	66,615	1,288,635	1,355,250
January, 1925	69,084	1,358,308	1,427,392
February	66,283	1,313,088	1,379,371
March	71,072	1,348,078	1,419,150
April	69,631	1,290,943	1,360,574
May	65,651	1,276,826	1,342,477
June	71,789	1,296,558	1,368,347
July	70,087	1,330,595	1,401,682
August	71,307	1,369,878	1,441,185
September	72,227	1,335,501	1,407,728

Data from Car Service Division reports.

Locomotive repair situation

Month	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No. req. running repairs	Per cent	Total req. repairs	Per cent
January 1, 1925	64,384	53,118	4,849	5,927	9.2	5,339	8.3	11,266	17.5
February 1	64,308	52,994	4,220	6,143	9.6	5,171	8.0	11,314	17.6
March 1	64,255	52,851	4,988	6,217	9.7	5,187	8.0	11,404	17.7
April 1	64,230	52,619	6,241	6,345	9.9	5,266	8.2	11,611	18.1
May 1	64,034	52,933	6,697	6,082	9.5	5,019	7.8	11,101	17.3
June 1	63,976	53,074	6,618	5,916	9.2	4,986	7.8	10,902	17.0
July 1	63,942	53,025	6,600	5,832	9.1	5,085	8.0	10,917	17.1
August 1	63,921	53,263	6,313	5,740	9.0	4,918	7.7	10,658	16.7
September 1	63,812	53,261	5,902	5,514	8.6	5,037	7.9	10,551	16.5
October 1	63,701	53,058	5,337	5,552	8.7	5,091	8.0	10,643	16.7

Data from Car Service Division reports.

Supply Trade Notes

William Jarvis Wickes, president of the United States Graphite Company, Saginaw, Mich., died on November 1, from heart trouble.

F. S. Hartwell has been appointed representative of the Davis Boring Tool Company, St. Louis, Mo., with headquarters at Rochester, N. Y.

Charles B. Ashmead has been appointed sales representative of S. F. Bowser & Co., Inc., Ft. Wayne, Ind., with headquarters at Cleveland, O.

Edward E. Roberts will in future represent, in the western part of New York state, the Firth-Sterling Steel Company, McKeesport, Pa.

Homer D. Williams, president of the Carnegie Steel Company, Pittsburgh, Pa., has resigned to become president of the Pittsburgh Steel Company.

E. K. Conneely, vice-president of the New York Air Brake Company, at New York, has resigned to become vice-president of the Pullman Company.

The Goodell Pratt Company, Greenfield, Mass., has purchased the portable electric drill business of the A. F. Way Company, Inc., East Hartford, Conn.

The Link-Belt Company, Chicago, has awarded a contract to the H. K. Ferguson Company, Cleveland, O., for a one-story, 120 by 260 ft. addition to its plant.

The Sullivan Machinery Company has moved its Sydney, New South Wales, office from Australasia Chambers, 3 Martin Place, to the Kembla building, Margaret street.

Stewart A. Davis, vice-president of the American Sheet & Tin Plate Company, Pittsburgh, Pa., died unexpectedly on November 5, in his home at Pittsburgh, at the age of 58.

Page & Ludwick, Chicago, have been appointed representatives in Illinois for the Magnetic Manufacturing Company, Milwaukee, Wis., and the Thomas Flexible Coupling Company, Warren, Ohio.

James A. Galligan has joined the sales department of the Union Railway Equipment Company, Chicago. Mr. Galligan was formerly vice-president of the Mortimer B. Flynn Coal Company of Chicago.

F. W. Stubbs, formerly mechanical engineer of the Chicago Great Western, has been appointed railroad representative of the A. M. Byers Company, Pittsburgh, Pa. Mr. Stubbs will be located in Chicago.

P. M. Brotherhood, 25 Church street, New York City, has opened an office at 7 Ashland avenue, Buffalo, N. Y., in charge of P. M. Brotherhood, Jr., who was manager of Manning, Maxwell & Moore's Buffalo office.

F. M. Cross, formerly manager of the New York pneumatic tool department of the Ingersoll-Rand Company, has been appointed manager of the pneumatic tool department for the Chicago territory, with headquarters at Chicago.

The Premier Staybolt Company, Pittsburgh, Pa., has appointed the American Railway Appliances Company, Borden building, New York, as its eastern representative, effective at once. The eastern territory includes all railroads tributary to New York.

L. F. Wilson, vice-president of the Bird Archer Company, with headquarters at Chicago, has been promoted to vice-president and general manager, with the same headquarters, and will have jurisdiction over production and operation including sales and service.

H. T. Herr, resident vice-president of the Westinghouse Electric & Manufacturing Company, in charge of the South Philadelphia works, hereafter will direct the general management of the Philadelphia plant and also that of the stoker works at Attica, N. Y.

William M. Zintl, of the advertising sales department of the Curtis Publishing Company, has been appointed director of sales of the paint and varnish division of the paint, lacquer and chemicals department of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

Scott Donahue, who has been representing the Pollak Steel Company of Cincinnati, Ohio, and the Edgewater Steel Company of Pittsburgh, Pa., with an office at 2615 Grand Central Terminal, New York, has also been appointed Eastern sales representative of the Graham Bolt & Nut Company, Pittsburgh, Pa.

G. W. Mead, president of the Linde Air Products Company, New York, has been elected chairman of the board; W. F. Barrett, vice-president, has been elected president; R. R. Browning has been elected vice-president in charge of sales activities and J. A. Rafferty, vice-president in charge of engineering, manufacturing and research.

M. J. Carney, president of the Prest-O-Lite Co. Inc., New York, has been elected chairman of the board; William F. Barrett, vice-president, has been elected president; Ralph R. Browning has been elected vice-president in charge of acetylene sales activities and R. J. Hoffman, has been re-elected vice-president in charge of storage battery and automotive divisions.

Ward G. Day, for the past seven years in charge of the service department of Fairmont Railway Motors, Inc., at Fairmont, Minn., has been promoted to special agent, with headquarters at New Orleans, La. Mr. Day's jurisdiction will cover the states of Texas, Louisiana, Mississippi, Alabama, Arkansas, Georgia and Florida. Carl Brhel has succeeded Mr. Day at Fairmont.

Henry J. Barnes has been elected vice-president of the Alumino-Thermic Corporation, Roselle Park, N. J. Mr. Barnes has been connected with the Alumino-Thermic Corporation for the past three years. Previous to that time he was for many years in the sales department of the Metal & Thermit Corporation, at the time of his resignation being district manager in charge of Canada.

William G. Clyde, senior vice-president and general manager of sales of the Carnegie Steel Company, Pittsburgh, Pa., has been elected president. Mr. Clyde was born in Chester, Pa., he attended the public schools of Chester and later entered the Pennsylvania Military College graduating with the class of 1888. He began work as civil engineer with Ryan & McDonald, constructors, of Baltimore, Md., and later became associated with Robert Wetherill & Co., machinists and founders of Chester. Mr. Clyde began his mill training with the Wellman Steel & Iron Company at Thurlow, Pa., as superintendent of the plate mills. subsequently going to the Illinois Steel Company, at South Chicago, where he remained for six years. He was then appointed sales manager for the American Steel Hoop Company at Philadelphia, remaining in that position until this firm was taken over by the Carnegie Steel Company. After serving three years in sales work at the Cleveland office Mr. Clyde was appointed assistant general sales manager of the Carnegie Steel Company, with headquarters at Pittsburgh, and in March, 1918, he was made vice-president and general manager of sales of this company.

W. G. Clyde

Four General Electric Company men were killed and two were injured in the train wreck which occurred on the Pennsylvania Railroad near Plainsboro, N. J., on November 12. The dead include R. D. Reed, a member of the General Electric industrial department and in charge of the sale of electric arc welding equipment; Mark A. Atuesta and Arthur W. Gross, members of the manufacturing department, and John C. Horstman of the manager's staff at the Schenectady plant. Among the injured were D. H. Deyoe of the industrial engineering department of the

company and Thomas Wry of the Lynn River works. All the men had met in Baltimore in connection with the Inter-works welding committee of the General Electric Company and were en route to the Bloomfield plant when the accident occurred.

J. H. Whiting, president and treasurer of the Whiting Corporation, Harvey, Ill., has been elected chairman of the board. Col. T. S. Hammond, who for many years has been vice-president and secretary, succeeds Mr. Whiting as president and treasurer. R. A. Pascoe succeeds Col. Hammond as secretary. R. H. Bourne succeeds Col. T. S. Hammond as president of the Grindle Fuel Equipment Company, a subsidiary of the Whiting Corporation, continuing also as vice-president and sales manager of the Whiting Corporation. N. S. Lawrence, vice-president and assistant sales manager of the Whiting Corporation, is also president of the Swenson Evaporator Company, another subsidiary of the Whiting Corporation. J. H. Whiting will remain actively engaged in the business, and no change of policy is involved on the part of the Whiting Corporation and its two subsidiaries.

Benjamin B. Greer, chief operating officer of the Chicago, Milwaukee & St. Paul, with headquarters at Chicago, has resigned. Mr. Greer has been elected president and a director of the New York Air Brake Company, New York, to succeed Charles A. Starbuck, who died on May 29. Mr. Greer was born on August 6, 1877, at Chicago, and began his business career with the Pullman Company in the summer of 1899. A few months later he entered the service of the Great Northern at St. Paul, Minn., as a clerk in the accounting department, after which he was successively material clerk in the superintendent's office, extra gang foreman, assistant roadmaster, chief clerk to the division superintendent and assistant superintendent, with headquarters at Minneapolis, Minn. Mr. Greer left the Great Northern in December, 1908, to become transportation inspector on the Chicago, Burlington & Quincy, with office at Chicago. He was promoted in 1910 to superintendent of the St. Louis terminal. In May, 1911, he became superintendent of the Hannibal division, and in January, 1912, was transferred to the St. Joseph division. In 1913, he was promoted to assistant to the general manager of the Lines East of the Missouri River, with headquarters at Chicago, and the following year he became assistant general manager of the Lines East. From 1915 to July, 1916, he was assistant general manager of the Lines West and then became assistant to the vice-president in charge of operation, which position he held until September, 1917, when he was elected vice-president and general manager of the Colorado & Southern. In November, 1917, he was also elected president of the Colorado Springs & Cripple Creek, with office at Denver, Colo., resigning these positions later in that year, to become assistant regional director of the Central Western region. In November, 1919, he was appointed federal manager of the Chicago, Milwaukee & St. Paul, the Ontonagon and the Escanaba & Lake Superior. On the termination of federal control in February, 1920, he became vice-president in charge of operation of the Chicago, Milwaukee & St. Paul, and subsequently served under the receivership as chief operating officer.

B. B. Greer

The Yates-American Machine Company has been organized through the consolidation of the P. B. Yates Machine Company, Beloit, Wis., and the American Woodworking Machine Company, Rochester, N. Y. J. E. McKelvey, president of the American Woodworking Machine Company, and P. G. Farrow, vice-president and general manager, C. E. McQurston, treasurer, and F. R. Smith, secretary, of the P. B. Yates Machine Company, will retain their respective positions in the new company. H. A. Von Oven, one of the trustees of the P. B. Yates Machine Company, who has been acting president since the death of P. B. Yates, has resigned.

Trade Publications

G-E flow meters.—Electrically operated flow meters for measuring steam, water, oil, gas, etc., are illustrated in a four-page bulletin issued by the General Electric Company, Schenectady, N. Y.

Electric tramrails.—"Mr. Keen Kompetitor" is the title of a brochure being issued by the Cleveland Electric Tramrail Company, Wickliffe, Ohio, showing the electric tramrail as it is used in various industrial shops for the moving of heavy loads.

Fire brick cement.—The uses of Adamant firebrick cement in the building of natural gas-fired boiler and oil-burning welding furnaces and in the furnaces of a mill and lumber company are described in three illustrated folders issued by the Botfield Refractories Company, Philadelphia, Pa.

Daily record chart.—A full-size reproduction of the daily record chart produced by the Twin Type meter has been issued in folder form by the Esterline-Angus Company, Indianapolis, Ind. The Twin Type meter elements are the same as those used in single meters, but two records, synchronized as to time, are produced on one chart.

Steel taped cable.—"The story of steel taped cable" is the title of a 24-page booklet issued by the Okonite Company, Passaic, N. J. The construction of the steel taped cable is shown in detail in this booklet, and a few of the manifold uses to which it may be put are pictured. Specifications and tables for cables of various voltages also are given.

Forging machinery.—A 10½-in. by 13½-in. book containing 20 pages of illustrated matter descriptive of the second exposition of National forging machinery recently held at Tiffin, Ohio, has been prepared by the National Machinery Company, Tiffin. This book is intended to bring the exposition to those who were unable to attend, and shows the progress in National machine forging equipment.

Wall chart of tool steels.—A 12-in. by 18-in. wall chart descriptive of the various grades of Vasco tool steels, the purpose for which each grade is particularly adapted, the proper heat treatment, etc., is being distributed by the Vanadium Alloys Steel Company, Latrobe, Pa., to toolroom foremen, master blacksmiths, purchasing agents and other mechanical executives interested in this tool steel.

Texrope drive.—Bulletin No. 1228, entitled "Allis Texrope Drive," has been issued by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis. After a brief summation of the advantages of the Texrope drive, its application is described and a graph for determining sheave diameter or distance between centers given. The method to be followed in laying out an Allis Texrope drive is then explained.

Grinding machinery.—Bulletins Nos. 84, 100, 120 and 174, descriptive of heavy duty face grinders, radial grinders, motor-driven buffing lathes and motor-driven floor grinders, respectively, have been issued by the Bridgeport Safety Emery Wheel Company, Bridgeport, Conn. The face grinder with a 32-in. sectional grinding wheel is designed for grinding guide bars and flat surfaces; the floor grinders and buffing lathes are of the heavy duty series, and the radial grinders are without belts, countershafts, or overhead suspension and operate in or out, up or down, on horizontal surfaces or surfaces at any angle and completely around their bases.

Bridgeport brass.—In commemoration of its sixtieth anniversary, the Bridgeport Brass Company, Bridgeport, Conn., has had reprinted and is distributing in pamphlet form an account of its development from 1865 up to the present day. Following an outline of the personnel of the company in 1865, the first American micrometer as it was originated in the shop of the Bridgeport Brass Company is described, and its subsequent development illustrated. Interesting references are made to the early use of brass in hoop skirts, clock parts, lanterns, telephone parts, condenser tubes, trolley wires, etc. The facilities now used in the Bridgeport shops for the production of sheet brass from copper and zinc are then pictured and several of the operations described.

Personal Mention

General

James Paul has been appointed assistant superintendent of motive power of the Atlantic Coast Line, with headquarters at the Uceta shops, Tampa, Fla., in charge of mechanical forces on the third division, and reporting to the superintendent of motive power, at Waycross, Ga.

Master Mechanics and Road Foremen

W. R. Witherspoon has been appointed master mechanic of the Atlantic Coast Line, with headquarters at High Springs, Fla., succeeding James Paul.

R. B. Tomlinson has been promoted to assistant road foreman of engines of the Virginia division of the Seaboard Air Line, with headquarters at Raleigh, N. C.

F. H. Greene, air brake foreman of the Moncrief shop of the Atlantic Coast Line, at Jacksonville, Fla., has been promoted to night foreman of the Waycross, Ga., enginehouse.

W. P. Kershner has been appointed master mechanic of the Central Kansas division of the Missouri Pacific, with headquarters at Osawatomie, Kans., succeeding S. L. Landis, promoted.

A. B. Wilson has been appointed assistant master mechanic of the Western division of the Southern Pacific, with headquarters at West Oakland, Cal., in place of H. J. McCraken.

D. R. Davis, traveling engineman of the Panhandle division of the Pennsylvania, has been promoted to assistant road foreman of engines of the Panhandle division, with headquarters at Columbus, Ohio.

C. L. Gibson has been appointed master mechanic of the Portland division of the Southern Pacific, with headquarters at the Brooklyn shops, Portland, Ore., succeeding D. M. McLaughlin, who has retired.

S. A. Welten, acting assistant road foreman of engines of the Eastern division of the Pennsylvania, has been promoted to assistant road foreman of engines of the Eastern division, with headquarters at Pittsburgh, Pa.

A. Howard has been promoted to assistant road foreman of engines of the Fifth and Sixth districts of the Union Pacific, with headquarters at Cheyenne, Wyo., succeeding H. L. White, who has been assigned to other duties.

H. J. McCraken, assistant master mechanic of the Western division of the Southern Pacific at West Oakland, Cal., has been promoted to master mechanic of the Stockton division, with headquarters at Tracy, Cal., succeeding C. L. Gibson.

W. H. Smith, assistant road foreman of engines of the Eastern division of the Pennsylvania at Pittsburgh, Pa., has been promoted to road foreman of engines of the Wheeling division, with headquarters at Wheeling, W. Va., succeeding O. B. Hays, deceased.

F. R. Butts, assistant master mechanic of the Brookfield division of the Chicago, Burlington & Quincy, at Hannibal, Mo., has been promoted to master mechanic of the Brookfield division, with headquarters at Brookfield, Mo., succeeding H. H. Urbach, transferred.

Shop and Enginehouse

V. B. Webb has been promoted to night enginehouse foreman of the Southern, with headquarters at Spencer, N. C.

J. S. Flowe has been promoted to night enginehouse foreman of the Southern, with headquarters at Greensboro, N. C.

George F. Mosby has been promoted to assistant enginehouse foreman of the Southern, with headquarters at Birmingham, Ala.

R. Kling, division foreman of the Missouri Pacific at Omaha, Nebr., has been appointed general foreman, with headquarters at Falls City, Nebr.

C. J. Thompson, night enginehouse foreman of the Missouri Pacific at Falls City, Nebr., has been appointed division foreman, with headquarters at Omaha, Nebr., succeeding R. Kling.

Purchasing and Stores

G. Harry Hopkins has been promoted to assistant storekeeper of the Atlantic Coast Line, with headquarters at High Springs, Fla.

J. H. Smith has been appointed division storekeeper of the Southern, with headquarters at Atlanta, Ga., succeeding G. A. Blackwell, deceased.

D. W. Metzdorf has been appointed acting general storekeeper of the Alaska Railroad, with headquarters at Anchorage, Alaska, succeeding Robert Huntley, who has resigned.

C. F. Monroe, foreman storehouse labor gang of the Atlantic Coast Line at Florence, S. C., has been promoted to assistant storekeeper, with headquarters at Savannah, Ga.

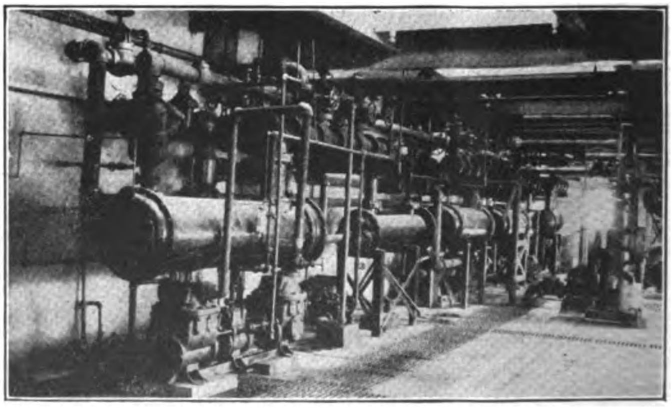
J. L. Cowan, formerly purchasing agent of the San Antonio & Aransas Pass, has been appointed tie and timber agent of the Southern Pacific lines in Texas and Louisiana, with headquarters at Houston, Tex., succeeding J. S. Wickett, who has resigned.

Car Department

E. H. Weigman has been appointed master car builder of the Kansas City Southern, with jurisdiction over the entire line and headquarters at Pittsburg, Kan., succeeding J. Gutteridge, who has been assigned to other duties. Mr. Weigman was born at DeSoto, Mo., July 29, 1892. In 1909 he entered the service of the Louisville & Nashville at East St. Louis, Ill., as a car repairer. He was later promoted to supervisor of the car department, with headquarters at Louisville, Ky., in which position he remained for eight years. For a period of six months in 1917, Mr. Weigman was assistant secretary of the old American Railway Master Mechanics' and Master Car Builders' Associations, under Jos. W. Tayler, secretary. For four years he was connected also with the Atlantic Coast Line as a traveling instructor in the car department, his headquarters being at Wilmington, N. C.

Obituary

Thomas S. Davey, shop superintendent of the Erie at Dunmore, Pa., died recently at his home at Scranton, Pa. Mr. Davey was born on March 11, 1876. In May, 1893, he entered the employ of the Delaware, Lackawanna & Western as a machinist apprentice. He finished his apprenticeship in May, 1898, and in August of that year joined the forces of the New York, Susquehanna & Western as a machinist. On March 1, 1900, he was promoted to gang foreman, and on April 1, 1901, became a machinist at Jersey City. On July 3, 1904, he returned to Stroudsburg as general foreman, and on January 1, 1911, was appointed master mechanic. On August 10, 1914, he became shop superintendent at Buffalo, N. Y.; on November 26, 1917, master mechanic at Secaucus, N. J., and on July 27, 1918, shop superintendent at Hornell, N. Y. On February 3, 1923, he was assigned to special work on crucible steel at Harrison, N. J.; on July 31, 1923, assigned to special work at Hornell and on January 7, 1924, was appointed shop superintendent at Dunmore.



Surface condenser equipment in the basement of the mechanical laboratory of The Pennsylvania State College